Moorepark'11

Irish Dairying | PLANNING FOR 2015

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Teagasc

Moorepark Animal & Grassland Research and Innovation Centre,

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The Irish dairy industry - Planning for 2015

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Despite Ireland's economic difficulties, 2010 was a very successful year for the agri-food sector resulting in a large increase in exports to a total value of approximately €8 billon per annum. The Food Harvest 2020 report proposes a 50 per cent increase in milk output for the Irish dairy industry using smart green technologies. There is general agreement within the industry that these targets can be achieved. This is made possible by the one per cent annual increase in milk quotas between 2009 and 2013 (as part of the 'Health Check' agreement) and the abolition of EU milk quotas in 2015. The abolition of quotas creates both exciting and challenging opportunities for the Irish dairy industry. For the first time in 30-years, Ireland can now plan to exploit our competitive advantage in milk production within a truly global market place fuelled by expansion on existing dairy farms and the entry of youthful new entrants to dairying. Irish farmers will now expand their businesses within a market environment where there is little supply chain management and greater price volatility - albeit around a higher average price. The expansion in output will also exert challenges to both the processing and marketing sectors to process the increased milk supply and market increased volumes of dairy products. A 50 per cent increase in milk production will require milk deliveries to increase from an average of 5.1 billion litres over the 2007 to 2009 period to 7.66 billion litres by 2020. The expansion in Irish milk production will increase the profitability of Irish dairy farms, create valuable new jobs within the national dairy industry and combined with value add at processing level; will be worth in excess of €1 billion to the Irish agri-economy in the next decade.

Any expansion in the dairy farm business should only be undertaken if it increases profitability and provides a better lifestyle to the farm family. In this environment, only those dairy farmers who fully capitalize on the inherent competitive advantages associated with low cost grass-based seasonal milk production systems will be successful. This will be based on using key technologies such as compact calving, higher stocking rates, high EBI replacements, high quality pasture management and low cost labour efficient farm infrastructures. Based on a provisional analysis of the 2010 Teagasc profit monitors completed, the top 10 per cent of dairy farmers obtained a net margin of approximately 18 c/l compared to 11.5 c/l for the average. After a deduction of 6 c/l for own labour, this is equates to a profit of €30,000 for the top 10 per cent of dairy farmers compared to €13,750 for the average based on a milk quota of 250,000 litres. The top 10 per cent of dairy farmers operated at a higher stocking rate yet produced higher milk yield and milk composition per cow. Similarly the top 10 per cent of dairy farmers achieved the higher profit with lower concentrate, fertilizer and machinery costs per litre. These results indicate that researched technologies in relation to grassland management and high EBI genetics were key into achieving the high profitability. These technologies will be even more important in the future in addition to providing a more enjoyable labour efficient lifestyle for dairy farmers and improving the overall environment sustainability of our industry.

The immediate challenge facing many dairy farmers is how best to plan between now and milk quota abolition in 2015. Milk quotas are still in place while at the same time dairy cow numbers are increasing in a scenario of high milk price; milk deliveries were 8.7 per cent over quota at the end of April 2011. There is mounting concern among some member states (Holland, Denmark and Ireland) at the Commission's refusal to further increase milk quota allocation or reduce super levy fines prior to 2015. The Commission is reluctant to change current EU dairy policy as the latest estimates show that milk production among the EU 27 countries is six per cent under quota. The current super levy fine is set at 28.5c/l. In this scenario, Irish dairy farmers must focus on cost reduction to allow profitability to be maximised within a fixed quota scenario. Dairy farmers that plan to expand milk production, once milk quotas are abolished, should now invest in areas that will increase farm productivity for the longer term e.g. breeding stock, grazing farm infrastructure and milking facilities.

This major event will provide a roadmap to long term high profitability dairy farming under Irish conditions. A summary of the most recent results from the comprehensive dairy research programme at Moorepark are presented in this open day booklet. This open day affords dairy farmers an opportunity to see the research results underpinning the technology required to deliver high profit sustainable dairy businesses and to meet research and advisory personnel from Teagasc. The financial support for the research programme from state grants and dairy levy research funds is gratefully acknowledged. Similarly the support of FBD Trust, the overall sponsors of Moorepark'11, is greatly appreciated.

PLANNING FOR 2015

Planning for 2015

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SUMMARY

- Dairy producers will need to focus on developing low cost production systems based on grazed grass in the future so as to ensure the financial viability of the dairy business in a market environment where there is an increased likelihood of input and output price volatility.

- The profitability of the whole dairy industry (farmers and processors) will be higher by focusing mainly on a seasonal supply pattern of milk based on spring calving systems of production.

- A detailed transition plan is now needed on dairy farms so as to best position dairy enterprises to expand profitably post milk quotas. Priority areas for on farm investment between now and 2015 are:

  - Breeding high EBI replacements.
  - Identifying and reseeding low performing pastures.
  - Development of efficient grazing infrastructures.
  - Developing labour efficient farmyard infrastructure.
  - Improving herd health status.
  - Developing skills in grazing management and financial planning.

INTRODUCTION

EU milk policy is due to change radically in 2015 with the abolition of milk quotas, which have put major constraints on the industry for the past 30 years. These changes provide a unique opportunity for Irish farmers to grow their business. A 'freer' market environment however will be associated with more price volatility. Farmers will now need to grow their business profitably in an environment where the price of milk as well as that of inputs can fluctuate widely. In the period up to 2015, farmers must avoid exposing the farm business to substantial super levy fines. The time frame (~3.5 years) for farmers generally to adapt to this change is relatively short.

RISK AND RISK MANAGEMENT

There is a certain amount of uncertainty in any business environment. This uncertainty can provide both opportunities and threats. Risk can be either positive or negative. The important question is how much is the business "at risk", or how vulnerable is the business to external factors such as weather, price change, etc? The impact of some of these external factors can become more pronounced in the growth phase of the business. Typically, when farms are in an expansion phase cash flow can become a major constraint and the level of borrowing also generally increases. It is anticipated that milk price fluctuation will pose the greatest risk to the dairy business in the future. However, there are also other significant risks such as the price of feed, fertiliser and fuel, as well as interest rates. Other factors such as weather and animal disease (BVD, IBR, Johnes, etc.) also pose risks. There may be other risks that are relevant depending on circumstance and location.

Figure 1 shows the volatility in prices of milk, concentrate and fertiliser over the period 1993 to 2010 (base year is 1991). It is evident that the volatility in price of both inputs and outputs has become much more pronounced since 2007. Farmers can best adapt to adverse price fluctuations by focusing on reducing the cost of production on their farms. There is evidence for this strategy globally where the lowest cost production systems are observed in the regions where price fluctuation is largest (e.g. New Zealand). For the business to survive price volatility, Irish dairy farmers will need to focus on developing low cost production systems. This will reduce the exposure to adverse price volatility for inputs and outputs. This strategy also ensures that while the business may not make substantial profit when price drops, it is much more likely to remain viable. A risk management plan should now be an integral part of any expansion plan on dairy farms. The plan should be stress tested against the effect of a number risks which could occur concurrently as was observed in 2009 (weather, milk and fertilizer prices).

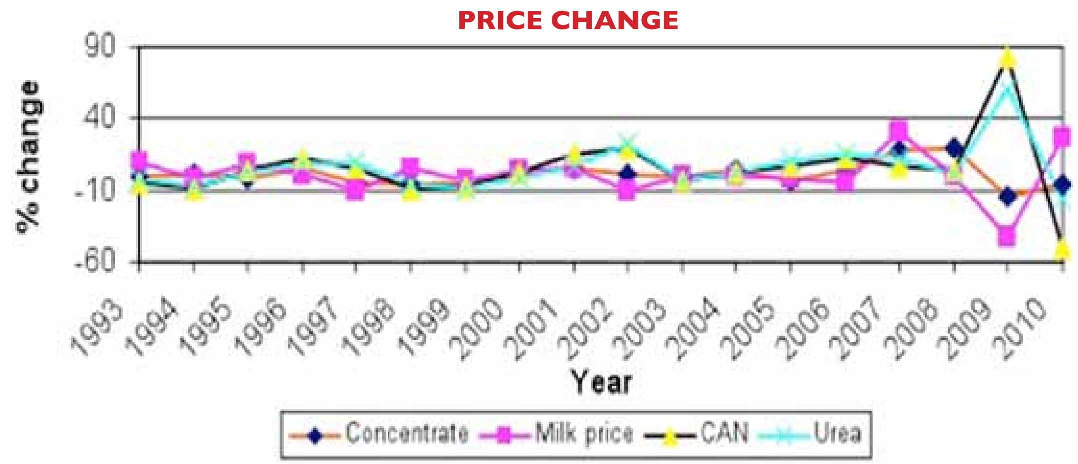


Figure 1. Volatility in key input and output prices between 1993 and 2010

DAIRY EXPANSION AND SEASONALITY

Expansion in national milk output (post milk quotas) will present major new challenges for the processing and marketing sectors. The potential for growth at farm level is only possible if the additional production can be sold profitably into existing and new markets. Expansion in milk production puts a new focus on the seasonality of production. The focus on this issue is important now as current processing facilities nationally are nearly at full capacity at peak supply. An increase in output with the current grass based system of production will increase the requirement for additional processing facilities. A recent study at Moorepark investigated the total industry costs (farm and processing sectors) associated with seasonal milk production compared with a relatively uniform supply pattern of milk. Two milk supply profiles were evaluated using farm (inside the farm gate) and processing sector models. In the baseline scenario the mean calving date was February 14th. This was compared to a scenario where 50 per cent of the national herd had a mean calving date of February 14th and 50 per cent had a mean calving date of October 1st. This resulted in the peak to trough ratio reducing from 5.5 to 1 to just over 2 to

1 (June to January). Investment assumptions around processing capacity for the seasonal supply curve were depreciated over a 15 year period and financed at 5 per cent interest. The average product prices between 2008 and 2010 were assumed in the analysis. At farm level, profitability was reduced by €115 million in the split spring/autumn calving scenario when compared to 100 per cent spring calving system. There was a gain at processor level of €49 million for a milk output of just over five billion litres of milk (national supply) in the split scenario. This modelling analysis shows that there is a significant net advantage associated with the seasonal milk supply model. It strongly suggests that any expansion in the national herd should follow a spring calving system of production. Dairy farmers will now need clear signals for the processing sector as to the market potential and processing requirements for the growth in the sector outlined in Food Harvest 2020. There is also the question of who is going to pay for the additional processing facilities required.

MILK QUOTA MANAGEMENT UP TO 2015

Individual milk producers have supplied milk well in excess of their milk quota in 2010/11. Farmers contemplating exceeding their milk quota in the current quota year and in the period up to 2015 need to be aware that there is now a real risk of super levy penalties as national herd size increases. Urgent attention to quota management is now required. Depending on the level of risk, a number of options can be considered. The quota management plan will also need to consider how the farm can be best positioned to grow post milk quotas. Options to consider include:

- Reduce or omit supplementary concentrate feeding
- Feed more milk to calves
- Purchasing milk quota
- Reduce milking frequency for part or all of the year
- Reduce lactation length
- Reduce herd size

The choice and number of options chosen will depend on the farm. The overall costs of production, and therefore profitability of the farm will be driver of the plan being implemented. For example, the purchase of milk quota will be a viable option for some farmers depending on costs of production, stage of expansion and location (milk quota exchange), while for others contracting the herd size maybe the only viable alternative where the farm is being operated at high cost, at high stocking rates and where there is a large amount of supplementary feed used.

Milk quota management strategies for three different farm case scenarios, where the farm has the potential to produce 11 per cent, 30 per cent and 50 per cent over their respective milk quotas, are described.

FARM 11 PER CENT OVER QUOTA

In this first scenario, a milk producer has the potential on their farm to produce 11 per cent over their milk quota in the 2011/12 milk quota year. This producer has to decide whether to exceed the quota available in a similar way to 2010/11 milk quota year, or whether they should take action on their farm to reduce the exposure to super levy fines. In Table 1 two options are presented. In option 1, the producer does not change their management decisions and ultimately incurs the super levy fine, while in the second option the producer takes action to reduce the exposure to super levy fine. In this analysis the farm has the potential to produce 400,000 litres with an actual milk quota of 360,000 litres. Reducing concentrate supplementation from 990kg of concentrate per cow to 350 kg (still allowing for 120 days of supplementation of up to 3kg/day) of concentrate per cow results in a milk sales reduction of approximately 10 per cent. This results in a small super levy fine of €418. If milk super levy applies to excess milk produced it will amount to €11,480. The overall farm profitability of the farm is increased by 40 per cent by following the strategy of reducing the level of concentrate feeding. In the event of no super levy applying and based on a milk price of 32 c/l, concentrate cost of €260/tonne and a response to concentrate of 0.7 litres milk/kg of concentrate, there would still be a small reduction in profitability from the high level of concentrate feeding.

Table 1. Mitigation strategies for a potential super levy exposure when farm has potential to exceed milk quota by 11 per cent

Milk Quota (l)	360,000	
	No change: pay super levy	Reduce exposure to super levy
Concentrate fed/cow (kg)	990	350
Milk deliveries (l/cow)	4,651	4,203
Cow numbers	86	86
Milk deliveries (l)	400,000	361,458
Super levy fine (€)	11,480	418
Net farm profit (€)	30,776	42,988

FARM 30 PER CENT OVER MILK QUOTA

In the second scenario, the farm has the potential to produce 30 per cent over the actual milk quota available in the 2011/12. Similar to the first scenario, the supplementary feed levels should be reduced and this will reduce milk output by approximately 10 per cent. The next option available is to milk cows once a day for part or all of the lactation. Table 2 presents a comparison of 'Once a Day' with 'Twice a Day' milking modelled from research conducted at Moorepark over a two year period. Cows were milked once or twice daily for the entire lactation. In this analysis, the reference milk concentration for the fat adjusted milk deliveries is 3.80 per cent. Full labour costs are included in the analysis with 25 per cent less labour in the once a day system (at a rate of €12.44/hour). The results presented show that if the herd was milked for the entire lactation twice a day the farm would have incurred a super levy fine of €39,938. Milking the herd once a day for the full lactation reduced milk output by 26 per cent. As a consequence, the potential super levy fine is reduced to €6,011. The profitability was €16,173 higher when the cows were milked once a day. There may be a requirement to sell cows with cell counts greater than 250,000 before embarking on once a day milking. If a 'concentrate effect' is also included in this scenario the super levy fine would be removed entirely.

FARM 50 PER CENT OVER MILK QUOTA

In the third scenario, the farm has the potential to produce 50 per cent over the actual milk quota available in the 2011/12. It is not possible to reduce milk output enough in this scenario to fully insulate against a super levy fine without selling some stock from the farm. Reducing concentrate feed (to the extent described) and milking cows once a day will have the effect of reducing milk output by approximately 35 per cent. Mature cows produce 25 per cent more milk than heifers, have the lowest EBI, have a higher probability of having a higher cell counts etc. A 10 per cent reduction in mature cows will reduce milk output by 11.5 per cent which, when coupled with the reduction in concentrate feed and a reduction in milking frequency, has the potential to reduce milk output by approximately 45 per cent.

Table 2. Effect of milking frequency on biological and economic performance

Milk Quota (l)	360,000	
Milking Interval	Twice a day	Once a day
Milk yield (kg/cow)	6013	4437
Milk solids yield (kg/cow)	437	351
Milk Sales (l)	490, 766	364,643
Total costs (€)	144,266	128,655
Milk returns (€)	167,938	136,193
Super levy fine (€)	39,938	6,011
Net farm profit (€)	13,057	29,230

KEY COMPONENTS OF PROFITABLE EXPANSION

Rapid dairy expansion will be possible post 2015 and individual dairy farmers should only expand their dairy enterprises if it increases farm profitability. The short to medium term outlook for a relatively high milk price is positive and it is likely that technically efficient farmers will generate significant amounts of surplus cash in their business over the next 3 years prior to quota removal. Farmers who are considering a long term future in dairying and expanding post quotas should use this time to prepare their businesses for the post quota era. The following aspects of the dairy farm business should be priority areas for investment between now and 2015.

BREED HIGH GENETIC MERIT REPLACEMENTS

Cows that are bred in 2012 and subsequent calves born in 2013 will themselves be calving down in a post quota environment (2015). While there is likely to be adequate dairy stock on farms from now until 2014 to fill the national quota, it is likely that in 2015 there will be an insufficient number of young high genetic merit dairy stock for both the expanding dairy farms and the new dairy conversions. Plans should be put in place to increase numbers of high EBI breeding females on farm between now and 2015.

IDENTIFY AND RESEED LOW PERFORMING PASTURES

Nationally, dairy farmers are utilizing 6.4 t DM/ha annually. There is significant potential to increase this with a realistic target of 11-12 t DM/ha achievable on farm. This will only be increased through the implementation of a plan that will result in increased herbage production, increased stocking rates and reduced concentrate supplementation. Farms should be monitored for overall and seasonal herbage production and individual paddock performance investigated. Soil fertility and reseeding programs should be implemented on every farm to increase herbage production and utilization. The stocking rate and supplementation levels on the farm should be based on the herbage supply versus demand relationship.

DEVELOP GRAZING INFRASTRUCTURE

The single biggest biological factor influencing the profitability of Irish dairy farms is the amount of grass utilised by the dairy herd. As well as growing large amounts of grass, a key requirement for profitable dairy farms will be the utilisation that grass over a long grazing season. This will require good grazing infrastructure such as farm roadways and suitable paddock and water systems.

DEVELOP A LABOUR EFFICIENT INFRASTRUCTURE

Most capital investments on dairy farms have a much longer life span than the milk quotas are projected to have. One of the factors that will limit the ability of farmers to manage larger herds will be inadequate time available for management because too much time is taken in daily work routines and in particular milking. Any capital investment on dairy farms undertaken between now and 2015 should be considered relative to the type and scale of farm business that will be operated post 2015. Investments should be judged based on their impact on farm output, labour input and total input costs in a non milk quota scenario. Investments that are likely to pay dividends post quota abolition are those that reduce time spent milking such as larger milking parlours and facilities that improve cow flow at milking.

IMPROVE HERD HEALTH STATUS

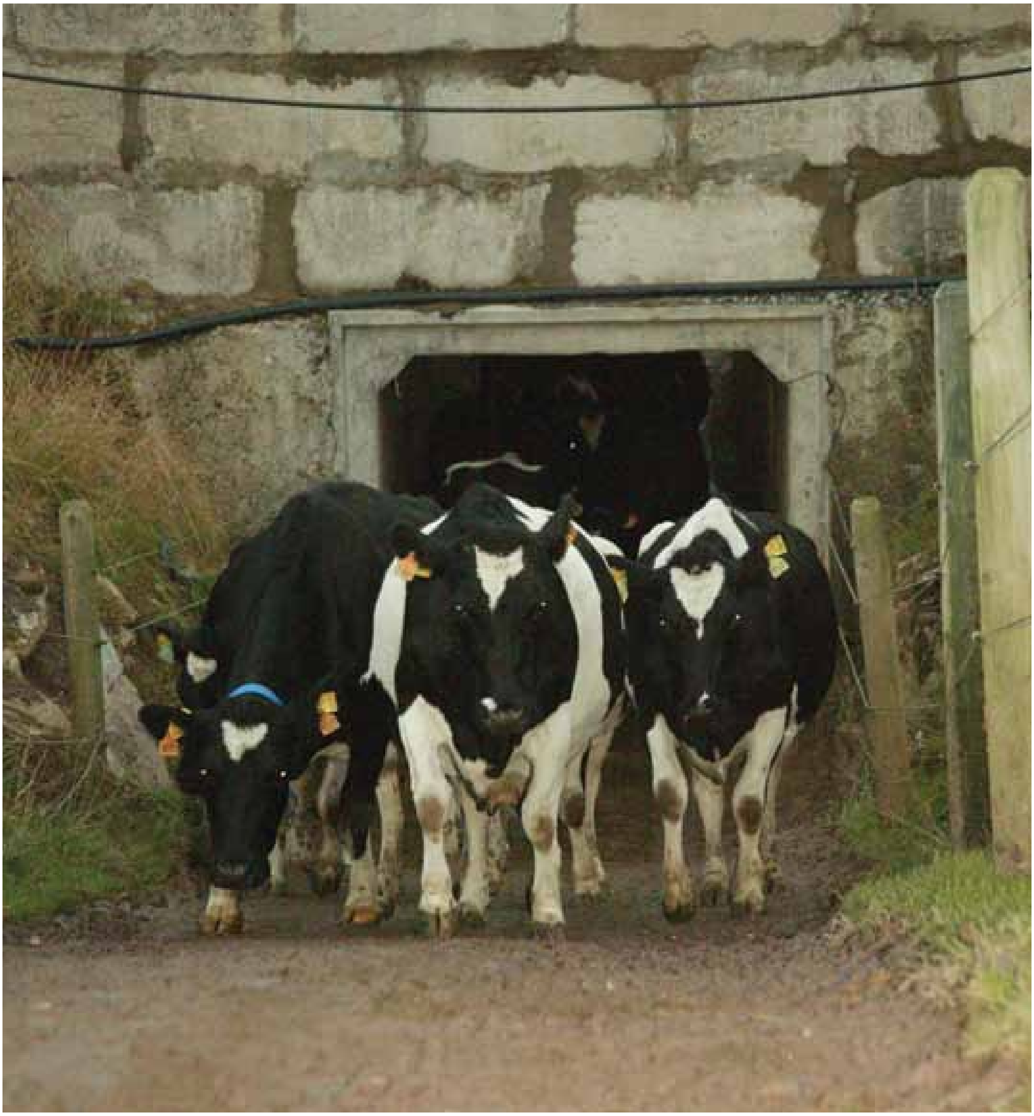
The health status of the dairy herd will determine whether any or all of the production and economic targets are met. Maintaining a healthy herd is one of the largest prerequisites to developing and maintaining a profitable dairy herd. The loss of livestock through culling or death has a substantial effect on the potential of the business to expand. The period between now and 2015 allows an opportunity to increase the health status of the dairy herd by developing a herd plan that includes getting to know the health status of your herd, implementing a good biosecurity protocol and preventing disease spread through targeted vaccination.

DEVELOP SKILLS IN GRAZING MANAGEMENT AND FINANCIAL PLANNING

The biggest factor determining the success of any dairy farm business is the ability of the farm manager to identify, quantify and deliver on the goals of the business. For seasonal grass based systems, the skills that will be required most in the post-quota era are grazing management and financial planning. These are skills that take time to develop and should be a priority for all dairy farmers/managers who intend to run successful dairy businesses post quotas.

CONCLUSIONS

The Irish dairy industry has now entered a period of transition as the effects of milk quota, which has limited the potential of the dairy industry for 30 years, are being removed. Expansion should only be planned if it is going to result in increased farm profitability and improved livelihoods. The significant net advantage associated with seasonality will ensure that spring calving grass based systems will be the most sustainable model into the future. However, there is likely to be more pronounced price volatility for inputs and outputs, and this is likely to be a key feature of the economic environment into the future. Milk quota management plans should be developed on all farms which will allow the farms to expand while minimizing the exposure to super levy fines. Farmers should prioritise surplus cash over the next three years for investment in technologies that will increase productivity from grass based milk production systems.



Milk production systems for an expanding Irish dairy industry

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SUMMARY

- The mindset on Irish dairy farmers must change to increasing profitability per hectare through grass utilized per hectare and cost control, the two drivers of farm profitability post quotas.
- Increased stocking rates in association with an appropriate calving date will deliver increased grass utilisation and milk solids production.
- Grass growth will limit productivity and grazing management practices must continuously present adequate high quality grass to the dairy herd while ensuring that the sward is properly conditioned for future grazing events.
- High EBI animals will deliver increased milk solids production within the context of higher stocking rate systems, while the efficiency of the system will be increasingly maximised with a smaller crossbred cow within larger scale and increasingly feed limited dairy herds.

INTRODUCTION

As a consequence of Ireland's natural comparative advantage in food production from grazed grass, the recent Food Harvest 2020 report conservatively anticipates a 50 per cent expansion in dairy production. The mindset and approach to milk production on Irish dairy farms must change after milk quotas are removed. Post quotas and with profitability per hectare as the core objective, Irish grass-based production systems must focus on increasing home grown pasture production and utilisation through new feed management objectives, increased stocking rates, accelerated cow and maiden heifers calving rates (90 per cent in 6 weeks; 50 per cent in 10 days), reduced supplementary feed usage and a more feed efficient dairy cow. The production system will continue to be based on a predominantly grass diet. In the next decade, fewer dairy farmers with increased operational scale will leverage increased productivity and profitability from grass based systems fuelled by leading edge management technologies. Every dairy farm business must use the intervening years to quota abolition to develop their farming operations in a manner consistent with the requirements of a vibrant and expanding industry for the future. This paper will describe the characteristics of profitable grass based systems post milk quota and the steps that farmers must now take to expand their dairy farm business for long term profitability.

THE DEFINING CHARACTERISTICS OF PROFITABLE MILK PRODUCTION POST MILK QUOTAS

Irish dairy farmers must revisit the very essence of their business. Our systems of production must allow expansion, be financially robust irrespective of fluctuations in product prices and interest rates, and be highly efficient per unit of land, labour, capital and environmental resources. A provisional analysis of 2010 profit monitor data indicates that while the average dairy farm completing profit monitor analysis in 2010 achieved a net profit (including return to own labour) of 11.5 cent per litre (c/l), the highest profit farmers achieved a 50 per cent higher profit based on higher value output (+1.9 c/l) and reduced feed (1.0 c/l) and fixed costs (3.5 c/l). On that basis, it is apparent that farms with increased reliance on grazing to achieve higher product quality and reduced external feed and fixed costs associated with increased mechanisation and confinement are achieving the greatest returns from dairy farming. Such systems are also more environmentally friendly and provide for a more enjoyable labour efficient lifestyle. Consequently, **high profit dairy farming must achieve the maximum level of milk solids production from the limited supply of feed available to the dairy farm** as home grown feed utilisation is likely to be the main long term limitation to profitable milk production.

To facilitate expansion, dairy farmers must implement technologies that increase pasture production and utilisation, improve nutrient use efficiency and increase both the proportion of grazed grass in the dairy cow diet and the amount of product which is subsequently produced. The following technologies should be implemented on Irish dairy farms to increase the overall efficiency of the production system and achieve increased farm profitability.

1. STOCKING RATE AND CALVING DATE

To capture the maximum benefits of grazed grass, the most fundamental management practice must be to have the correct number of cows calving compactly at the beginning of the grass growth season. Stocking rate, traditionally expressed as cows per hectare (ha), is widely recognised as the major factor governing productivity from grass. Previous research indicates that, while milk production per cow is reduced, milk production per hectare will tend to be maximised at higher stocking rates as increased animal demand drives more efficient grazing practices and improved sward utilisation. While delivering superior per hectare productivity, increased stocking rates result in a farm system where winter feed production capability is reduced and so increased stocking rates may result in increased feed and capital costs (associated with accommodating and feeding increased numbers of animals). Ultimately, the optimum stocking rate for an individual farm is that which gives the maximum sustainable profitability per hectare and will be dependant on the individual farms grass growth capability and the relative value of imported feed and milk solids produced. On the basis that Irish farms have the potential to achieve annual pasture production of 16 tons DM per hectare based on best practice grazing technologies, the recommended best practice stocking rate for an enclosed production system is 2.94 cows/hectare. This indicates that with a current average mean stocking rate of 1.9 livestock units/hectare, the Irish dairy industry has the potential to increase milk production significantly through increased stocking rates and improved grass utilisation.

In seasonal grazing dairy systems, the planned start of calving, the calving rate (pattern) and the mean calving date are critical in terms of optimising the match of feed supply and herd feed demand in early spring. Calving should be concentrated just before the start of the grazing season to maximise grass utilisation and minimise feed supplementation. At a given stocking rate, the correct calving date will maximise animal performance by increasing the length of lactation as well as having a high level of production per day of lactation. Calving too early, in particular at higher stocking rates, will lead to underfeeding or a requirement for increased supplementation as grass growth rates will be unable to match herd demand in early spring. A spread out calving rate or delayed calving date will lead to reduced grass utilisation. In general, the herd should be calved as early as possible, provided that it can be fed adequately from a predominantly grazing diet throughout the lactation. While there is no ideal mean calving date that will be appropriate to every farm (due to differences in ground conditions, spring growth rates, higher stocking rates, etc.), a mean calving date of February 15 to 25th with 90 per cent of the herd calved in 42 days appears to be generally appropriate for most Irish dairy farms in comparison to the current average mean calving date of March 15th.

2. GRAZING MANAGEMENT PRACTICES

Grazing management for high animal productivity is based on a common sense approach to continuously present adequate high quality grass to the dairy herd while ensuring that the sward is properly conditioned for future grazing events. The relatively low level of milk productivity currently achieved on Irish dairy farms (NFS, 2009; 670kg of milk solids/hectare with concentrate supplementation of approximately 700 kg/cow) indicates that while there are also other contributory factors, best practice grassland management has not been widely adopted and current practices continue to limit the productivity of Irish farms. Recent grazing studies at various Teagasc facilities reveal that where appropriate grazing management practices (including maintaining optimum pregrazing herbage masses, postgrazing residuals, rotation lengths and soil fertility) are combined with measurement to identify and reseed underperforming pastures, high annual pasture growth (in excess of 14.5 tons DM/ha/yr) can be achieved, regardless of location.

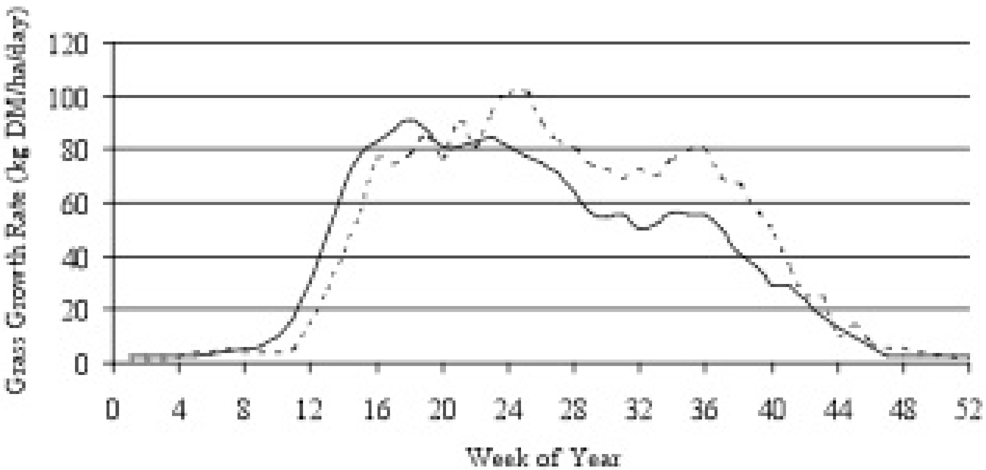

Figure 1. Grass growth rates at Moorepark (____) and Ballyhaise (----) during 2005, 2006 and 2007

Figure 1 compares the growth rates for Ballyhaise Agricultural College, Co. Cavan and Curtins Farm, Moorepark during the years 2005 to 2007 (inclusive). The graph illustrates that while increased growth rate occurs 2 weeks earlier at Moorepark, mid-season growth is consistently higher at Ballyhaise. Management practice at both sites has focused on increased grazing severity and reducing pre-grazing herbage yields to improve pasture quality and increase regrowth rates. While similar pasture production can be achieved regionally, pasture utilisation on wetter soils is more challenging. In recent years, the selection for a lighter crossbred cow, use of on/off grazing and flexible grazing management to prioritise wetter soils within the farm in conjunction with increased investment in grazing infrastructure (including multiple access points to paddocks with good roadways and water infrastructure) has allowed the Ballyhaise College dairy herd to achieve a grazing season of 280 days at pasture, with animals kept indoors on few occasions between mid-February and mid-November. Increased emphasis on flexible grazing of wetter soils has allowed management to avoid pasture damage and compromised regrowth and, in conjunction with reseeding of underperforming pastures, is anticipated to result in similar overall growth and utilisation at Ballyhaise Research farm and Moorepark in future years.

3. THE REALISATION OF APPROPRIATE ANIMALS POST MILK QUOTAS

The overall success of high performance grazing systems is based on creating the ideal environment within the farm to grow higher quantities of higher feed value pasture for larger better fed dairy herds to realise record levels of productivity. A steadily increasing proportion of all milk production costs (approximately 25 per cent in 2010) are associated with feed provision on Irish dairy farms and consequently every effort must be made to achieve the maximum return from feed. The dairy heifer calf conceived in 2012 will produce milk in a production environment post quotas where feed availability defines not just her productivity, but also several other important functions such as her capability for growth and ability to maintain body condition and achieve good reproductive performance. Recent results at Teagasc Moorepark have shown that higher EBI animals will deliver increased milk solids production within the context of such systems, while exhibiting superior reproductive performance when compared to lower EBI animals.

In selecting animals for a future scenario of larger and increasingly feed limited herds, breed choice also provides opportunities for Irish farmers. In a review of grazing experiments at Moorepark in recent years, average daily pasture intakes of 17 kg DM/cow were reported for Holstein Friesian cows of approximately 550 kg of mid-lactation body weight, (equivalent to only 3.1 per cent of bodyweight). In comparison, intake data from the Ballydague research farm indicates that Holstein-Friesian Jersey crossbred animals of approximately 450 kg bodyweight are achieving intakes equivalent to 3.6 per cent of bodyweight. An increased intake per kg bodyweight generally results in increased milk production per kg bodyweight (i.e. a more productively efficient dairy cow). As smaller cows have lower absolute daily energy demands during lactation which can be satisfied from grazing alone, it can be concluded that the increased intake capacity of the crossbred within our grazing system is partially responsible for the high milk production and improved health and vigour of crossbred animals reported in international grazing studies. Indeed, the financial review of the Ballydague breed comparison study estimates that selection for a smaller Holstein-Friesian x Jersey crossbred dairy cow could further increase overall farm profitability by 30 per cent (equivalent to €400/hectare/year) by virtue of higher animal performance and excellent reproductive performance within low supplementation grazing systems in the future.

CONCLUSIONS

High profit dairy farming occurs where high levels of milk solids productivity are achieved from the limited supply of feed available to the dairy farm. Increasing stocking rate in association with an appropriate calving date will increase the productivity of Irish dairy farms post EU milk quotas. As producers aim for larger and higher EBI herds, pasture growth will limit productivity and consequently every effort should be made to adopt grazing management practices that ensure high annual pasture productivity, while the selection of a crossbred dairy cow has the potential to further increase animal productivity and farm profitability.

Turning grass into money

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SUMMARY

- Ninety per cent of the feed requirement of the spring calving herd should be produced from grazed grass and grass silage.
- Use the 'Spring Rotation Planner' to guide the first grazing rotation.
- Graze swards to 3.5 cm in the first rotation, avoid over grazing in early spring as it reduces cow performance and grass production.
- From late April to August target pre-grazing yields of 1300-1600 kg DM/ha (>4 cm) and a post grazing height of 4.0-4.5 cm.
- Milk production in mid-season (May to August) will be maximised when cows are allocated approximately 17-18 kg DM daily of high quality pasture.

INTRODUCTION

The Irish dairy industry is beginning to adjust in anticipation of quota abolition. Among the main catalysts creating this transformation are ongoing trade liberalisation and the phasing out of EU milk quotas coupled with a simultaneous increase in the cost of silage production, home produced cereals and imported feedstuffs. The efficient utilisation of grazed grass is an avenue to maintaining the competitiveness of the Irish dairy industry. Grazed grass is cheaper by a factor of 3.0 compared to grass silage and concentrate feeds. Farmers must now target 1250 kg milk solids/ha using 300 - 600 kg of concentrate DM/cow to maximise profitability; 90 per cent of feed requirement will be obtained from pasture. This paper deals with grazing management practices that will achieve high dairy cow performance from grazed grass.

MAXIMISING THE POTENTIAL FROM GRAZED GRASS IN EARLY SPRING

The period from calving to breeding is a critical time for both cow and grassland management. Cows should be turned out to grass as soon as possible post-calving as this will increase milk production performance, particularly milk solids production, and reduce costs. Profitability will increase as higher cost feeds such as grass silage and concentrate are reduced or eliminated from the diet. The 'Spring Rotation Planner' should be used by all farmers to budget the available grazing area until the end of the first grazing rotation (usually around April 7th - magic day – when grass growth equals grass demand). Farm grass supply (farm cover) must be measured in conjunction with using the 'Spring Rotation Planner' to ascertain the quantity of grass offered to the cows during the first rotation.

SPRING ROTATION PLANNER

The best way of managing grass in spring is to set out the area you are going to graze weekly and implement this plan during the spring period. The 'Spring Rotation Planner' is a tool which provides clear guidance at this time. The planner incorporates turnout date, weekly calving pattern, grazing area and the targeted finish date of the first rotation. The Spring Rotation Planner is available from your local Teagasc advisor. Table 1 summarises the proportion of the farm to be grazed by three key points in the early grazing season.

FOR THE PLAN TO BE SUCCESSFUL, THE FOLLOWING IS REQUIRED:

- Stick to the target area allocated by the planner, do not graze more or less per day
- Post-grazing height in the paddock should be 3.5 cm ensuring high quality grass in the next rotation
- If after allocating the correct portion of the farm, post grazing height is >3.5 cm then feed allocation is too high, concentrate should be phased out. If grass is in short supply the cows should be supplemented.

Table 1. Spring grazing area allocations

Week end date	% of total farm area grazed at week ending
1st February	Start grazing
1st March	30% grazed
17th March	66% grazed
April (7th -10th)	Begin rotation 2

SPRING GRAZING – DO NOT OVER-GRAZE!

A study carried out in 2010 and repeated this year at Teagasc Moorepark investigated the effects of different post-grazing heights on dairy cow milk production performance, grass growth and sward quality from turnout to the start of the breeding season (18th April). Swards were grazed to either 2.7 cm or 3.5 cm during this 10-week period. After 2 – 3 weeks milk yield differences became evident and continued for the remainder of lactation. Cows grazing to 3.5 cm had higher (+11%) cumulative milk yield and (+17%) milk solids production than cows grazing to 2.7 cm (Table 2). It is clear that this reduction in performance has a severe effect on immediate and cumulative lactation performance. The recommendation from Moorepark research is to graze to 3.5 cm and avoid overgrazing (grazing less than 3.5 cm) in early spring. If grass supply is inadequate then additional supplement should be offered in the form of concentrate or grass silage.

Table 2. Effect of post-grazing sward height from turnout (February 10th) in spring to the start of the breeding season (April 18th) on dairy cow performance

	Grazing Treatment	
	2.7 cm	3.5 cm
Milk yield (kg/day)	20.3	22.7
Milk fat content (%)	4.27	4.47
Milk protein content (%)	3.14	3.25
Cumulative milk solids yield (kg)	90	108
Bodyweight (kg)	466	477
Body condition score	3.03	3.03

CONTROLLING MID SEASON GRASS SUPPLY – USE THE 'GRASS WEDGE'

During the mid-season the farm should be walked at least once a week and farm cover details recorded. The information must then be used to make critical decisions regarding the quantity of feed available to the herd. The 'grass wedge' is a simple method used to interpret this data. A profile of the amount of grass available in each paddock (kg DM/ha), from highest to lowest paddock is set out on a graph. The grass wedge visually illustrates the breakdown of the grass supply across the farm.

A target line is superimposed onto the graph from the target pre-grazing yield for the grazing herd to the target post grazing yield. This line depicts the target herbage mass required in each paddock to meet demand in the next rotation on the day the wedge is created, e.g. 1,400 kg DM/ha in Figure 1. If the paddocks are above the target line there is surplus grass on the farm, if they are below the line there is a grass deficit (grass is in short supply).

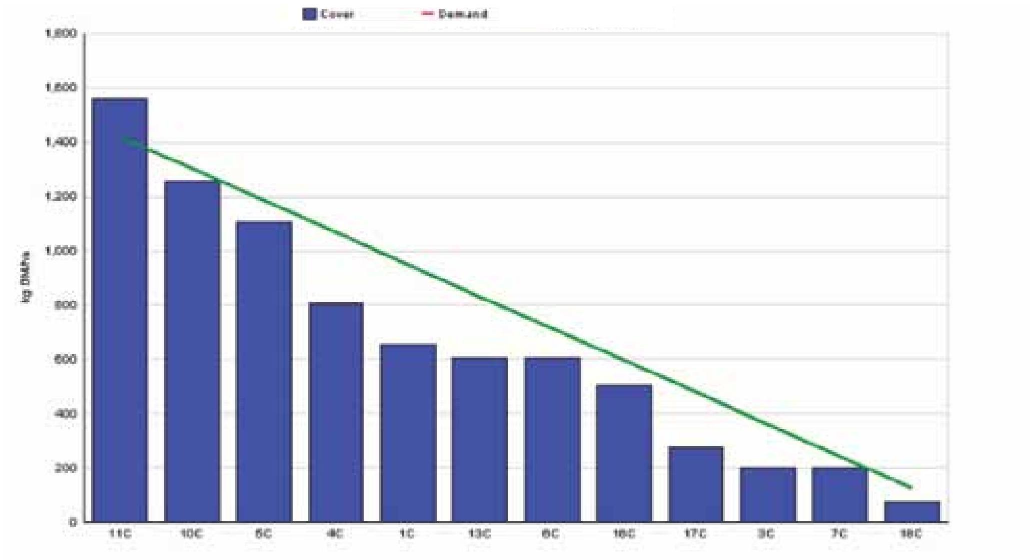

Figure 1. Grazing wedge with the demand line starting at 1400 kg DM/ha (the ideal pre-grazing yield) and finishing at 100 kg DM/ha (~4 – 4.5 cm sward height; the ideal post-grazing yield)

TARGET PRE-GRAZING HERBAGE MASS

An experiment was carried out at Teagasc Moorepark in 2010 to compare three different pre-grazing herbage masses (low – 1,000 kg, DM/ha, medium – 1,500 kg DM/ha and high – 2,300 kg DM/ha) for dairy cows. Daily herbage allowance was 17 kg DM/cow/day (> 4.0 cm). Grazing cows at low and medium herbage masses had higher milk and milk solids yield, and improved grass utilisation. Grazing low mass swards resulted in cows grazing double the area of the high mass and 30 per cent more area than the cows grazing the medium herbage mass. This meant that the grazing rotation for the low mass herd was close to 14 days. Short grazing rotations (<16 days) have negative effects on grass production as the sward never reaches the '3 leaf stage'. Three leaves are achieved on a grass plant after approximately 20-21 days regrowth at the stage when the sward reaches canopy closure; this occurs at a herbage mass of between 1300-1600 kg DM/ha. Another negative aspect of grazing low pre-grazing herbage masses (<1,100 kg DM/ha) was that the cows had to graze for 1.5 hours longer to achieve 94 per cent of the grass intake of the medium heritage mass cows. The recommendation is therefore to target pre-grazing yields of 1300-1600 kg DM/ha during the period from April to late August and to graze paddocks out to 4 – 4.5 cm. When herbage mass increases above this threshold the paddock or paddocks should be harvested for round bale silage, closed for a main cut of silage or grazed by non lactating stock.

AUTUMN GRAZING MANAGEMENT

The grazing season begins in autumn, i.e. autumn grassland management is one of the main factors influencing grass availability the following spring. The two main objectives of autumn grazing management are (1) to maximise the proportion of grazed grass in the diet of the dairy cow during this period, and (2) to finish the grazing season with the desired farm cover. Sufficient grass for the remainder of the grazing season can be accumulated by increasing rotation length to greater than 30 days from mid-September. Pre-grazing herbage mass should be maintained below 2,500 kg DM/ha, if this is exceeded other stock (e.g. dry cows) should be used to graze the paddock(s).

Grass budgeting is essential to ensure that these objectives are achieved. The '60:40' rule is recommended as best practise (see Table 3). Aim to have at least 60 per cent of the farm closed by the end of the first week of November and graze the remaining 40 per cent from then until housing.

Table 3. Autumn closing management

Week end date	% of total farm area grazed
10th October	Start closing the farm in rotation
7th November	60% Grazed & Closed
1st December	Full time Housing

The final grazing rotation should commence on 10th October – every paddock grazed from this date onwards should be closed (this may be two to three weeks earlier in more northerly regions to compensate for lower growth rates in late autumn and early spring). During the final grazing rotation post-grazing residuals of 100 to 150 kg DM/ha (4.0 cm) should be targeted to encourage over winter tillering. Each day delay in closing after 10th October will reduce spring grass supply by approximately 15 kg DM/ha.

CONCLUSIONS

Early turnout and grazing to 3.5 cm in the first rotation is a good compromise between achieving high milk output from pasture in early lactation and achieving high grass utilisation. During the main grazing season the key is to offer the grazing herd grass at the '3 leaf stage', therefore, pre-grazing herbage masses of between 1300-1600 kg DM/ha should be targeted. In autumn do not increase rotation length too early and try to target pre-grazing herbage masses of less than 2,500 kg DM/ha. The key tools for implementing a successful grazing management program are the spring rotation planner, grass wedge and 60:40 autumn grass budget.

Genetics to maximise profit from grass

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SUMMARY

- Breeding is an integral component of profitable dairy production systems.
- The economic breeding index (EBI) is a profit based index which should be used to identify genetically elite animals for Irish production systems.
- Genomic selection is a method which supplements the traditional method of genetic evaluation with the objective of improving the accuracy of identifying genetically elite animals.
- Crossbreeding trials at Moorepark have demonstrated significant animal performance benefits. The key must be to utilise the best available genetics (high EBI) to maximize the benefit and ensure real genetic improvement.

INTRODUCTION

The ideal cow for Ireland is a cow that will efficiently deliver high milk solids from grazed grass with little fuss, and continue to go back in calf year on year. Robust reliable cows will ensure profit generation regardless of the volatility in milk and input prices that the future is expected to present. The ongoing research at Moorepark as well as close collaborations with industry partners such as the Irish Cattle Breeding Federation (ICBF), as well as trial results and tools such as the EBI, the Active Bull list, genomic selection, the National Breeding Programme etc. provide Irish dairy farmers with the where with all to identify the most profitable genetics for the Irish grass-based environment, and ensure a prevalence of new and relevant bloodlines. With each passing year further progress is being made resulting in a larger choice of quality bulls from a range of dairy breeds that will increase the profitability of the national herd. It must be appreciated that genetic change, be it improvement or otherwise, is cumulative and permanent.

THE ECONOMIC BREEDING INDEX-A TOOL TO IDENTIFY ELITE ANIMALS

The economic breeding index (EBI) has been available to Irish dairy farmers as a tool to identify the most profitable animals under average production systems. The availability of sub-indexes within the EBI allows farmers to "fine-tune" the selection of bulls to address particular issues in their herd. As with all national breeding objectives, the EBI is being constantly revised in light of changing economic policies as well as availability of additional data and greater understanding of "novel" traits. The most recent addition to the EBI being the inclusion of a 'Maintenance' sub-index which takes cognisance of cow size (weight) reflecting its contribution to feed cost. This autumn will see the revision of the genetic evaluation for fertility and survival in dairy cattle which as well as utilizing collected insemination and pregnancy diagnosis data will also increase the number of parities included in the evaluation from three to five. This is likely to improve the reliability of fertility proofs for most bulls, especially young bulls.

The representation of animal health in the EBI is currently below optimum because of the lack of routine recording by farmers of disease incidence on-farm. This is arguably one of the most vital components that needs greater consideration. Unless health information; mastitis, lameness, retained afterbirths, milk fever, etc. are recorded, the impact of selection using the EBI on these traits cannot be accurately identified and therefore no corrective measures incorporated if necessary.

INCREASING THE ACCURACY OF IDENTIFYING ELITE ANIMALS USING GENOMICS

Key to a successful breeding program, either nationally or on-farm, is the accurate identification of the best (and worst) animals. At birth, a prediction of animal genetic merit is obtained by averaging the genetic merit of the respective sire and dam. However, because progeny inherit different pieces of DNA from the parent, in a relatively random process, an accurate itself prediction of the actual genetic merit is not known until the animal has performance records itself and/or has many progeny with performance records.

HOW DOES IT WORK?

At the end of the day, performance is driven by the genes of the animal and how those genes are affected by the environment the animal is exposed to. Genes, which are made up of DNA, remain with an animal throughout life and are identical in every cell of the body. So in other words, the genes in the follicles of a new born calf's hair are the same as the genes in that animal's carcass many years later. Therefore, knowing the genes of a newborn calf and how each gene affects performance allows us to more accurately determine how that animal would perform in the average environment many years later. This is the science underpinning genomic selection.

Currently we measure 54,000 pieces of DNA in an animal although the technology is now available to measure almost 800,000 pieces of DNA (High Density genotyping platform). However, the short-term benefit of using more pieces of DNA is expected to be small. Of greatest importance is accurate knowledge of the association between each piece of DNA and the range of performance traits where data is available.

GENOMIC SELECTION IN IRELAND?

Key to obtaining accurate estimates of the association between each piece of DNA and performance is a large database of both the DNA profile of animals and their performance under Irish production systems. This database in Ireland is currently up to 4,500 AI bulls which is larger than in most countries yet smaller than some countries like North American and the Eurogenomics consortium in Europe (includes The Netherlands, France, Germany and Viking Genetics based in Denmark). It is a well known fact that the greater the number of animals in this database with both DNA profiles and performance (either themselves or in progeny), the greater will be the benefit of genomics through more accurate identification of genetically elite animals. Ireland is constantly discussing with international collaborators on sharing of DNA information. Genomic selection is currently undertaken on all traits in the EBI including milk production, fertility, calving performance, beef performance and both somatic cell count and lameness. Genomic selection will soon be available on type traits. Genomic selection could be undertaken for other traits such as retained afterbirths or clinical mastitis if sufficient data were recorded and available for analysis. Such information could be used to identify animals at risk of certain diseases and could therefore be managed accordingly.

IMPLEMENTATION OF GENOMIC SELECTION

The implementation of genomic selection on-farm is relatively simple. The ICBF can be contacted and a hair sampling kit ordered. A hair sample from the switch (i.e. very bottom) of the tail of the newborn calf can be taken and returned to the ICBF. They will send the sample to a laboratory who will extract the DNA from the hair follicles and determine the DNA profile of the calf. This information will be used to supplement the parental average information of the calf resulting in an increase in reliability.

Because individuals inherit chunks of DNA from their parents it is not always necessary to know the full DNA profile of all animals. A reduced DNA profile can be used to predict or impute the full profile once the full DNA profile of the sire and maternal grand sire is known. A reduced DNA profile halves the cost to €50 (incl. VAT) but can only be undertaken if the full profile of the sire and maternal grandsire are in the ICBF genotype database. This can be checked when ordering the hair sampling kit.

IMPACT ON GENOMIC SELECTION IN IRELAND

The reliability achievable for bulls evaluated based on their DNA is approximately 54 per cent although this will vary depending on the information available from their pedigree. This is an increase of approximately 22 percentage units compared to if genomic selection was not used. However, 54 per cent reliability is still considerably less than the maximum of 99 per cent achievable in proven (older) bulls. Nonetheless, the genetic merit (e.g. EBI) of the best genomically selected bulls is on average superior to the genetic merit of most proven bulls, available at a reasonable price. The lower reliability of genomically selected bulls can be overcome by using teams of these bulls; a recommendation is to use at least four genomically selected bulls in a team. **Use of less than four genomically selected bulls in a herd is not recommended and should never be undertaken.**

CROSSBREEDING – ADDITIONAL BENEFIT

Ten years ago the term "high genetic merit" was synonymous with high milk producing Holstein-Friesians. Since the introduction of the EBI in 2001, and the results from a number of 'strain comparison studies' the focus has well and truly switched to the more holistic 'profit per cow'. Now, the concept of crossbreeding in the dairy herd has gained considerable acceptance and uptake on the strength of the sound scientific output emanating from our 'Ballydague' and associated research studies. Fundamentally a successful crossbreeding strategy aims to 1) introduce favourable genes from another breed selected more strongly for traits of interest, 2) remove the negative effects associated with inbreeding depression, and 3) to capitalise on heterosis or hybrid vigour, where crossbred animals usually perform better than that expected based on the average of their parents. Estimates of heterosis vary in magnitude depending on the trait being examined. Heterosis for production traits is usually in the range 0 to 5 per cent, whereas heterosis for traits related to fertility is usually in the range 5 to 25 per cent.

The performance data generated at Ballydague (Jersey) and on the large on-farm study (Norwegian Red) demonstrates that crossbred dairy cows are capable of production levels per cow similar to their Holstein-Friesian contemporaries. However, fertility and survival levels are markedly improved with the crossbred cows. Economic analysis conducted using the biological data generated from these studies has highlighted a substantial profit benefit per lactation with the Jersey×Holstein-Friesian and Norwegian Red×Holstein-Friesian cows compared to pure Holstein-Friesian cows. The difference in performance equated to +€18,000 and +€13,000, respectively, annually from the analysis based on a 40 ha farm. This equates to over €180 and €130/cow/year more profit, respectively. This economic analysis took into account differences in production characteristics, body weight differences, replacement rates/survival, cull cow and male calf values, etc. The improved profitability is primarily attributable to improvements in milk revenue and the large differences in reproductive efficiency/longevity observed with the crossbred herds. Independent research undertaken by ICBF has indicated a potential benefit from cross-breeding of some €100/lactation in the first cross over an above that explained by EBI.

This year the first 3-way-crossbreds (Norwegian Red×Jersey×Holstein-Friesian) calved down at Ballydague. Preliminary performance results are positive indicating favourable production, fertility and body condition score characteristics – see updates available at regular intervals at: http://www.agresearch.teagasc.ie/moorepark/.

When selecting non-Holstein-Friesian sires, the first and most important thing to remember is that you continue to use high EBI sires. Based on the research findings, using a Jersey AI sire with an EBI of €200 will result in progeny with an increased profit per lactation of €300 (i.e. €200 from the direct genetic effect, plus another €100 from hybrid vigour). Similarly, using a Jersey sire with an EBI of €100 will only return an additional profit of €200, which is less than many of the top Holstein-Friesian sires. This fact must be borne in mind – otherwise the benefits of cross-breeding will be negated by the use of inferior sires. You should remember also that the heterosis effect (€100/lactation) does not get 'passed on' to the next generation, but will be reduced by up to 50 per cent after generation one depending on the strategy taken thereafter.

Going forward crossbreeding is expected to make an even greater contribution on Irish dairy farms in light of current and expect policy and the consequent drive by the industry to maximise output/profit per ha and reduce costs. This is indicated from other parts of the world, e.g. New Zealand and other such environments (similar grass growing and increasingly similar economic circumstances) where we find further evidence that the crossbred cow is most profitable.

CONCLUSIONS

Genetic gain in profitability is key to a long-term successful dairy enterprise. Genetic improvement for Irish dairy farmers should constitute increases in herd productivity through genetic improvement in milk solids output potential, and reduced costs by genetically improving reproductive efficiency/survival as well as animal health (udder health, lameness, etc.). It also should be noted that improvements to calving interval and survival (fertility sub-index) will improve productivity via potentially longer lactation lengths as well as increasing the proportion of cows reaching maturity and the consequential increased production capacity that ensues. Moreover, it must be appreciated that genetic change, be it improvement or otherwise, is cumulative and permanent.

Getting calving pattern right

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SUMMARY

- Calving pattern is a pivotal driver of farm profitability.
- Correct management of BCS during the dry period, early lactation and breeding period is a vital component of herd nutritional management that has a major effect on cow fertility.
- Early identification of anoestrous cows allows time to take appropriate action.
- It is critically important that submission rates are maximised.
- Use herd fertility records to calculate measures of reproductive performance in your herd. This will allow you to identify specific areas to improve. Over time this will improve the herd calving pattern.

INTRODUCTION

For most spring-calving systems, the breeding season will commence sometime between mid-April and the first week of May. The primary objective must be to get as many cows pregnant as quickly as possible after the start of the breeding season. This is critically reliant on achieving high submission rates. A schematic diagram of the breeding season is depicted in Figure 1. This can be divided up into the three distinct periods: (i) pre-breeding; (ii) the period of AI use; and (iii) the period of natural service bull use.

BREEDING PROGRAMME FOR COMPACT CALVING

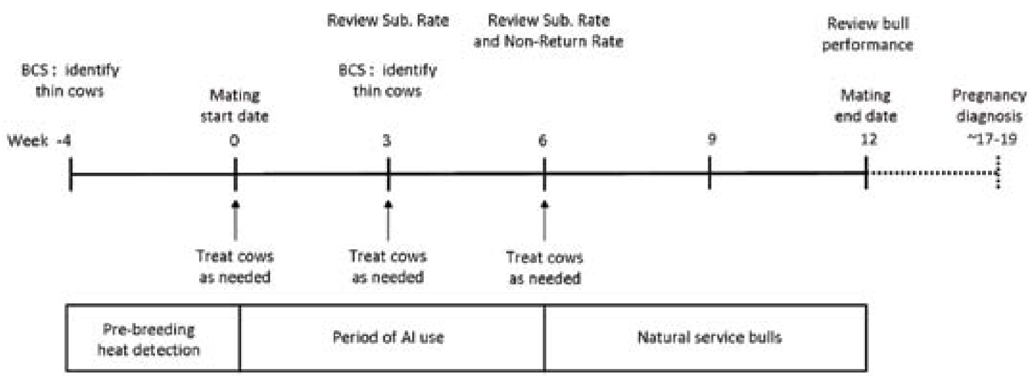

Figure 1. Schematic outline of the breeding period

PRE-BREEDING PERIOD

Body condition should be measured 4 weeks in advance of mating start date (MSD), ideally on the same day that pre-breeding heat detection begins. Thin cows are more likely to be anoestrous, respond poorly to hormonal treatments, and are generally difficult to get in-calf. If the average BCS is considerably below target, immediate action should be taken. Options include:

(i) increased daily grass allowance; (ii) increased concentrate supplementation; or (iii) placing thin cows on once-a-day milking until pregnancy has been achieved.

Pre-breeding heat detection provides many advantages. At MSD, you will be able to anticipate when cycling cows will next come on heat (i.e. week 1, 2 or 3 of the breeding season). You will also have a list of all cows that have not yet been seen in heat; these cows should be examined prior to MSD, and treated if necessary to get them bred at the start of the breeding period. The following is a simple pre-breeding heat detection programme using tail paint.

1. Apply tail paint of one colour (e.g. red) to all milking cows 28 days before the planned MSD. Apply red paint to late calvers as they join the milking group.
2. Check the tail paint on all milking cows **twice weekly** (e.g. after morning milking) until MSD. Depending on weather conditions, cows may need to be topped up with red paint. Record all cows that have had tail paint removed, and paint with a different colour (e.g. green).
3. At mating start date, any cows with red paint are unlikely to have been in heat during the preceding 28 days. Cows with green paint have been in heat at least once during the same period. Calculate the proportion of cows not cycling by MSD. Treat non-cycling cows that are calved more than 32 days with the CIDR-TAI protocol outlined by Herlihy and Butler – page 58.

PERIOD OF AI USE

From MSD onwards, heat detection efforts need to be stepped up for the period of AI use, which should be at least 6 weeks. Three periods of observation (at least 30 minutes each) should be carried out each day. Periods of observation ideally should take place when cows are generally inactive (i.e. lying down, ruminating). This improves the chances of picking out groups of restless cows that are more likely to be in heat. Check for signs of heat 2 hours after the morning milking, early afternoon, and again at 2 hours after the evening milking.

If pre-breeding heat detection is carried out as outlined above, you should switch to a new paint colour after cows have been inseminated (e.g. blue). This will allow you to rapidly get a picture of how your submission rates are progressing. Cows with blue paint have been inseminated. Cows with green paint were detected in heat before MSD and you should know roughly when to expect them to return to heat. Cows with red paint have not yet been inseminated and have not been observed in heat.

The key target for submission rate is 90 per cent of cows bred in the first three weeks of the breeding season. See the paper by Herlihy and Butler on pages 58-59 on the use of synchronization protocols to maximise submission rates.

PERIOD OF NATURAL SERVICE BULLS

Ensure bulls are in good body condition, and have reached the correct bodyweight for their breed and age well in advance of the breeding season. Purchased bulls should be sourced from clean herds, screened for infectious diseases, and vaccinated with the same vaccination programme as the cows. Bulls should be purchased 2-3 months in advance of when you plan to use them. The number of bulls required will depend on (i) herd size; and (ii) the proportion of the herd already pregnant to AI. For a 100 cow herd, with AI for 6 weeks resulting in approx. 50-70 per cent of the herd in-calf, a minimum of 2 bulls will be required. If <50% of the herd is in-calf after 6 weeks of AI, 3 bulls will be required. Discuss specific bull requirements for your herd with your advisor or veterinarian.

If possible, rotate the bulls used with the cows. After a week of activity, libido will be restored by resting for a few days to a week before returning to the milking cows. Where herd size allows, keep more than one bull with the milking herd at a time. Monitor bulls carefully for signs of body condition loss, lameness, lethargy, etc. Observe bulls to ensure that they are serving correctly.

It should be apparent that you cannot have a compact calving pattern if you do not have a compact breeding period. The target breeding season duration (AI use plus natural service bulls) should be ~12 weeks. Most farmers have a breeding period considerably longer (15-18 weeks) than this target. In this instance, it is advised to gradually move towards the target in a planned structured manner over three to five years to avoid excessively high culling rates. Decide on a date to remove the bulls and stick with it.

REVIEWING PERFORMANCE AND TAKING ACTION

Establishing precise herd fertility performance figures is an essential component of good management practice. This allows you to compare your herd performance against accepted targets. To improve herd fertility performance, identify the specific areas where performance is suboptimal, and develop a coherent strategy for improvement. Reproductive performance should be reviewed periodically throughout the breeding season, and again more thoroughly after breeding has finished. The calculations and the targets for the main reproductive performance indicators are outlined below.

Measurement	Calculation	Target
Cows not calved by MSD (%) =	$\frac{\text{No. of cows not yet calved at MSD}}{\text{Total no. of cows in the herd}} \times 100$	0%
Cows not cycling by MSD (%) =	$\frac{\text{No. of cows not detected in heat before MSD}}{\text{Total no. of cows that you plan to breed*}} \times 100$	<30%
3-week submission rate (%) =	$\frac{\text{No. of cows bred in first 21 days}}{\text{Total no. of cows that you plan to breed*}} \times 100$	90%
6-week submission rate (%) =	$\frac{\text{No. of cows bred in first 42 days}}{\text{Total no. of cows that you plan to breed*}} \times 100$	100%
6-week in-calf rate (%) =	$\frac{\text{No. of cows pregnant in first 42 days}}{\text{Total no. of cows in the breeding herd}} \times 100$	75%
Final pregnancy rate (%) =	$\frac{\text{No. of cows pregnant at final pregnancy diagnosis}}{\text{Total no. of cows in the breeding herd}} \times 100$	>90%

**This should include any cows that have not calved, but you plan to breed.*

The targets outlined are difficult to achieve in practice, but will result in improved overall farm efficiency and profitability. If your herd is below target for the measurements outlined above, the questions that should be asked are why, and what do I have to do to improve cow fertility? What changes to the management routine need to be put in place to improve performance? Can I establish a plan that will get my herd to the target performance level in two years (or three years or five years)? Careful identification of the genetic, health, and husbandry factors responsible for poor fertility is the best long-term strategy to improve cow fertility. Some key areas are outlined below:

» Examine the genetic merit of the herd. What is the herd average EBI and the average fertility sub-index? This can be easily assessed using ICBF reports. See the paper by Cummins and Butler on pages 55-57 for a more detailed discussion on the importance of the fertility sub-index in seasonal calving systems.

» If the figure for cows not seen in heat before MSD is greater than 30 per cent, pre-breeding heat detection efforts need to be improved and existing herd calving pattern should be examined (i.e. too many late calving cows).

» Examine BCS. The target herd average BCS at MSD is 2.9. If the cows that have not been seen cycling have low BCS, improve their energy status by increasing grass allowance and/or concentrate supplementation. Alternatively, consider reducing milking frequency to once a day for cows below target BCS.

» Is the diet properly balanced for energy, protein and minerals? Are grazing conditions adequate to allow the necessary grass intake? If very little or no concentrates are fed during the breeding period, are trace minerals being supplemented in an alternative way (i.e. bolus, inclusion in drinking water)?

» What is the health status of the herd? Were there problems with calving difficulty, retained membranes, metritis? If yes, these cows should be examined and treated appropriately in advance of MSD.

» Is mastitis a problem? Mastitis has a negative effect on fertility; implement changes to the milking routine and parlour hygiene to minimize spread between cows.

» Establish whether infectious diseases are prevalent on the farm (BVD, IBR, Leptospirosis, Salmonella, Neospora, Mycoplasma bovis, etc.)? These diseases negatively impact reproductive performance. Any necessary vaccinations should be carried out well in advance of the breeding season according to the manufacturers guidelines. Strict biosecurity should be employed to minimize risk of disease introduction to a naive herd.

CONCLUSIONS

The first step to improving herd fertility is to establish the fertility performance figures for your herd. Focused periods of intensive management are required during the pre-breeding period and the period of AI use. Achieving a compact calving pattern is beneficial for herd management during the following spring, allows longer lactations, greater grass utilisation, and increased profitability.

Achieving a healthy herd

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SUMMARY

- Know your herd health status – through good stockmanship and use of new laboratory screening tests to establish your herd health status.
- Prevent disease introduction by biosecurity – talk to your local vet about what additional tests might be useful on bought-in stock.
- Prevent disease spread by vaccination – discuss how to get maximum value out of your spend on vaccines with your local vet.

INTRODUCTION

The key components of achieving a healthy herd are developing a herd health plan with your local vet who will advise you on making prudent use of currently available diagnostic tests, improving your farm biosecurity and medicating where appropriate. Consult your local vet now about a herd health plan combining these three components designed specifically for your herd.

Recent Teagasc and DAFM surveys of dairy herds nationally have shown that antibodies to infectious diseases are widespread in our dairy herds;

- » Leptospirosis, BVD and IBR (over 80 per cent of herds antibody-positive)
- » Salmonellosis (65 per cent)
- » Johne's disease (30 per cent)

These are herd-level figures but the proportion of animals within herds which are antibody positive is much lower, e.g. on average less than five per cent of animals are positive for Johne's disease within positive herds.

In addition, exposure to these infections (presence of antibodies) needs to be kept in context. The presence of antibodies is not the same as active infection causing clinical disease. For example, such infections are often incriminated in poor herd fertility. However, cow nutrition, body condition, grassland management, genetics, AI management, heat detection and non-infectious disease control are equally important aspects of herd fertility.

ANIMAL HEALTH IRELAND

At a national level, Animal Health Ireland (AHI) is providing a framework to improve Ireland's herd health status through science-based, consensus-driven advice and recommendations. Teagasc research and advisory staff are currently actively engaged in AHI Technical Working Groups dealing with biosecurity, BVD, calf health, IBR, Johne's disease, mastitis and parasitic diseases.

SO WHAT CAN YOU DO TO ACHIEVE A HEALTHY HERD?

There are three key steps in a veterinary herd health plan; **1)** know your herd health status, **2)** prevent disease introduction, **3)** prevent disease spread by vaccination. In addition, it is up to you to monitor your own control programme. You are in the 'driving seat'; start the process by sitting down with your local vet and design a herd health plan together using these three simple steps to achieve a healthy herd (Figure 1).

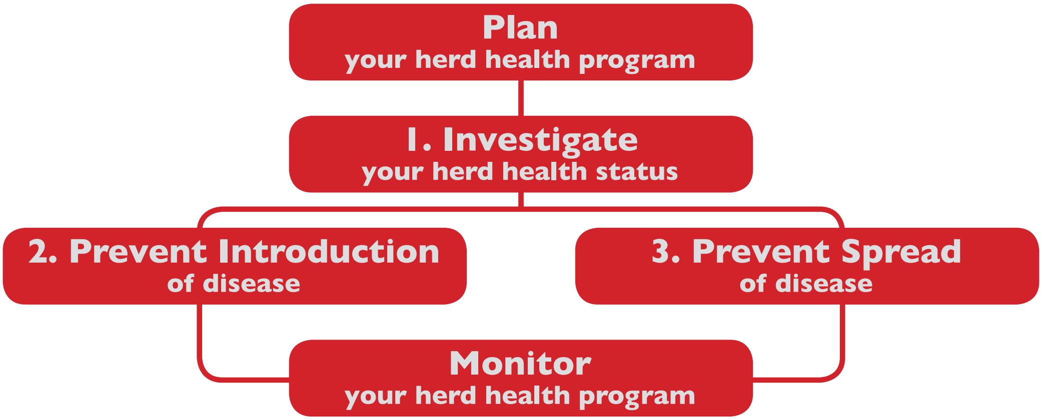

Figure 1. Herd health plan to achieve a healthy herd

STEP 1: *INVESTIGATE YOUR HERD HEALTH STATUS*

The simplest way to keep an eye on your herd health status is to herd your stock regularly for clinical signs of disease and to use your local vet to diagnose problems at an early stage. In addition, there are now new diagnostic tests that allow economical screening of herds using:

- Bulk milk testing (BVD, fluke, IBR, leptospirosis, neosporosis, salmonellosis, worms)
- Individual milk testing (BVD, IBR, leptospirosis, Johne's, neosporosis, salmonellosis)
- Targeted blood sampling of weanlings (BVD, leptospirosis)
- Pooling of blood samples to reduce costs (BVD)
- Ear-notch testing (BVD)

These test methods can be used to give a starting point from which to decide, in conjunction with the clinical herd history, what to do next, e.g. the implementation of biosecurity and or vaccination protocols, what tests you need to do on bought-in cattle and which animals to cull based on test results. A list of laboratories providing testing for BVD is shown in Table 1. If you are using 'distance diagnostics' (test results and advice independent of your local vet) it is advisable to discuss this information with your local vet. Samples collected as part of a herd health plan in conjunction with your local vet provide the vital interpretation of the results specific to your herd health history.

STEP 2: *PREVENT INTRODUCTION OF DISEASE*

With herd expansions likely to increase in the phased lead up to quota abolition, bought-in stock will become a major source of disease transmission. Currently, nine out of ten dairy farmers carry out no additional routine herd health screening when buying-in cattle. Biosecurity in its simplest form means the implementation of measures to prevent the introduction and spread of infectious diseases:

» A closed herd policy (i.e. no cattle movement, including bulls, onto the farm) will prevent the direct transmission of disease onto a farm. Ireland is currently one of the few EU Bluetongue disease-free countries; importation threatens this.

» Testing of bought-in stock should include more than TB and brucellosis. Diseases such as BVD, IBR, Johne's and Neospora can all be tested for (Table 1). The most dangerous animal is the pregnant animal as the fetus may be infected and the dam test-negative ('Trojan animals'); the calf needs to be tested also. Non-pregnant, non-lactating cattle bought over the summer are the lowest risk.

» On-farm biosecurity measures, such as quarantine, stock and disease-proof boundaries (to prevent nose-to-nose contact and breakouts/breakins) and footbaths increase protection against the introduction of infectious diseases.

Table 1. Diagnostic laboratories currently providing testing for BVD*

Laboratory	www.	Antibody to BVDv	BVD Virus
Agri-Food & Bioscience Ins.	afbini.gov.uk	Blood, milk	Blood, milk, ear
Animal Health Lab	animalhealthlabs.ie	Blood, milk	Blood, ear
Dairygold Herd Health Lab	dairygold.ie	Milk	Milk
Enfer Diagnostics	enfergroup.com	x	Blood, ear
FBA Lab	fba-labs.com	Blood, milk	Blood, milk, ear
Glanbia Central Lab	glanbia.com	Milk	Milk
Independent Milk Lab	imlabs.ie	Blood, milk	Blood, milk, ear
Irish Equine Centre	irish-equine-centre.ie	Blood, milk	Blood, milk, ear
Oldcastle Lab	oldcastlelabs.ie	Blood, milk	x

**List sourced from the Animal Health Ireland website; full details available at www.animalhealthireland.ie. Note that the State Laboratory Service, DAFM, must be used for official testing for BVD*

STEP 3: *PREVENT SPREAD OF DISEASE BY VACCINATION*

A recent Moorepark survey of Teagasc clients found that of the 450 dairy farmers who responded to the survey, 87 per cent were using at least one vaccine. Vaccine costs now average between €5 and €20/cow on many dairy farms. Leptospirosis, clostridial disease (e.g. Blackleg), BVD, and salmonellosis were the most common diseases farmers vaccinated against (Figure 2).

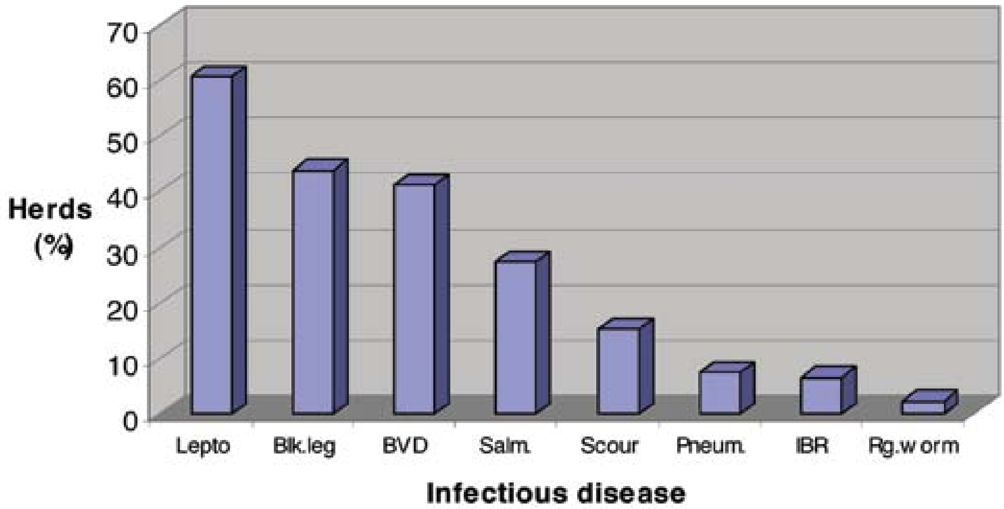

Figure 2. Vaccine use (per cent of herds) amongst Irish dairy farmers

Vaccination programmes are best implemented where there is close veterinary involvement in the decisions: Whether to use a vaccine or not? Which vaccine to use? When to administer the doses? Vaccines should be viewed as a component of a herd health plan but not the sole means of disease prevention within a herd as is commonly the case. Over-reliance on vaccination without the backup of proper compliance, management and biosecurity can lead to real or apparent vaccine breakdown. If you find it difficult to remember when to vaccinate it is worthwhile designing with your vet a simple calendar of which month which animals need to be vaccinated on one sheet of paper and stick this up beside your farm files and in the dairy. Pick a date and stick to it. In addition, write these dates, and when you need to order product, into your diary each year. Linking vaccination dates to prominent calendar dates also helps, e.g. *'first lepto vaccine dose for heifers on St Valentine's Day and second dose on St Patrick's Day'*.

MONITOR YOUR CONTROL PROGRAMME

Once you have decided to implement a control programme through a herd health plan you need to check that it is working year after year. You can do this by:

- Routine herding of stock to pick up early signs of disease
- Monitoring of records to detect changes in performance
- Testing/treating bought-in stock
- Use of screening tests to detect a change in herd health status.

In addition to monitoring for disease you need to monitor the control programme itself, e.g. has the timing of your vaccination programme drifted over the years?

CONCLUSIONS

Recent advances in herd testing and in national information sources (AHI) mean that you are now in a much better position to 1) establish your herd health status, 2) prevent disease introduction and 3) prevent disease spread by vaccination. Achieving a healthy herd is as important a goal in your business as having good herd fertility or good milk solids production as all three are interconnected and ultimately determine your bottom line.

ADVANCING THE NEXT GENERATION

Advancing genomic selection

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SUMMARY

- Genomic selection supplements the traditional method of genetic evaluation with information on the DNA of an animal to improve the accuracy of identifying genetically elite animals.
- Greater gain can be achieved by applying genomic selection to females as well as males.

INTRODUCTION

Genomic selection is now the method of choice for most dairy genetic evaluations worldwide. In spring 2009, Ireland was the second country in the world to launch genomic selection. The procedure involves supplementing the traditional method of genetic evaluation with information on the DNA of an unproven animal. The result is an increase in the reliability of the animal's proof. As DNA remains the same for an animal across its lifetime, the increase in accuracy from genomic selection can be achieved from birth.

UPTAKE OF GENOMIC SELECTION IN IRELAND

Since its initial launch in 2009 the uptake of genomic selection in Ireland has been strong. In 2009 genomically selected (GS) bulls accounted for 34 per cent of the total AI straws sold in Ireland; 2010 saw this figure increase further to 40 per cent. One of the main reasons for the rapid adoption of this technology by Irish dairy farmers is the greater EBI of the GS bulls (€218 in 2010) compared to the Irish daughter proven bulls (€146 in 2010). The reliability of available young bulls increased from 32 per cent prior to genomic selection to 54 per cent with genomic selection. Although the reliability of the GS bulls is lower than for most Irish proven bulls, the associated increase in the EBI of the GS bulls has seen a strong uptake among Irish farmers. However, as the reliability of the GS bulls remains relatively low, farmers are adhering to the advice given and using an average of four GS bulls per herd to spread their risk.

ADVANCES IN GENOMIC SELECTION IN IRELAND

Fundamental to generating a benefit from genomic selection, is knowledge on the DNA profile most suited to Ireland. A population of Irish proven animals, commonly known as a training population, is used to relate the DNA profile of the individual animals to their genetic merit for the array of traits evaluated by the ICBF. As Figure 1 shows the greater the size and the more diverse the DNA profiles contained within the training population the greater will be the benefit in accuracy from using genomics. Through international collaboration, the training population in Ireland has more than quadrupled from 945 domestically proven animals in 2009 to 4,196 in 2011. This training population size is still lower than in some countries and is reflected in lower increases in reliabilities from genomic selection. When genomic selection was initially launched in 2009 the service was only available for animals that were at least 50 per cent Holstein due to the small size of the training population for Friesians. Genomic selection, however, is now available for Friesians. Other recent advances include the development of genomic selection for linear type traits; initial results show an increase in the reliability of the type traits by approximately 10 percentage units.

GENOMIC SELECTION ON FARM

Genomic selection is now available to all dairy farmers. ICBF provide two genotyping services: the low density "3k" (i.e. 2,900 markers) platform or the normal density "50k" (54,001 markers) panel. Because animals inherit large chunks of their DNA from their parents, animals that have both their sire and maternal grandsire genotypes in the ICBF database (now 9,000 genotypes) can avail of the lower-cost 3k genotype service; while other animals can avail of the 50k genotype service; the cost of each service is €50 and €99, respectively. Farmers can log onto the ICBF website and see which animals can avail of the lower cost service.

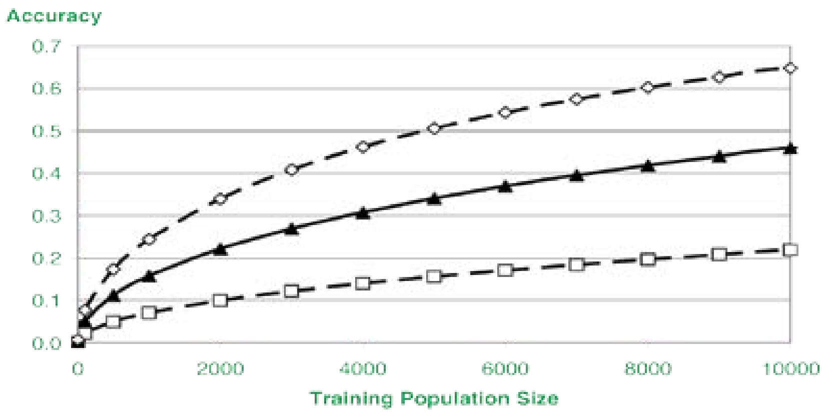

Figure 1. Effect of training population size on accuracy of genetic evaluations using cows with data on fertility (-☐-), calving (-▲-), and production (-◊-) traits

THE USE OF FEMALES TO EXPLOIT GENOMIC SELECTION

To date the focus of genomic selection has been on the male side; however, the female has an increasingly important role to play. Studies have shown that the genotyping of females can substantially increase the size of the training population thereby improving the accuracy of the genomic EBIs. The genotyping of females can potentially result in a three fold increase in the rate of genetic gain. An economic analysis confirms that genotyping females can result in very high rates of return on the investment.

Although genomic selection has progressed rapidly since its inception, there are still many other areas where further gains can be made. Our continued role in international collaborations ensures that Ireland remains at the forefront of this cutting edge technology. The swapping of genotypes with international partners ensures that the training population will continue to grow thereby increasing the reliability of our genomic EBIs. Access to more DNA markers may increase genetic gain further and expedite its application to multiple breeds.

CONCLUSION

The success of genomic selection has been due to the support and involvement of the entire industry, from research carried out by Teagasc, its implementation by the ICBF, the investment in infrastructure at Weatherbys to generate the DNA Profile, and the large uptake by dairy farmers. Teagasc and the ICBF will continue to work closely with the industry to further enhance genomic selection and ensure that the benefits are realised at farm level.

Emerging technologies in animal breeding

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SUMMARY

- Genomic selection has revolutionised animal breeding, but there are several emerging areas of research currently under investigation to further increase genetic gain.
- Technology is now available to measure milk fatty acid content, especially saturated fat content, on all milk recorded cows and bulk milk samples at no extra cost.
- Development of a sentinel "Next Generation" herd will allow monitoring of expected trends in key traits from breeding, and how these elite animals perform in contrasting production systems.

INTRODUCTION

The tools used in animal breeding have changed dramatically in the past decade, from the introduction of a multi-trait selection index, the EBI in 2001, to the launch of genomic selection in Ireland in 2009. Research into animal breeding is continually evolving and there are several new and exciting projects currently underway at Moorepark, many in collaboration with the Irish Cattle Breeding Federation (ICBF). Here, we summarise some of these areas of research, which include improving the use of existing technologies to further increase genetic gain, as well as identifying new traits of interest and disseminating the research results back to farmers in novel, easy to use, and easy to understand applications.

FURTHER EXPLOITING EXISTING TECHNOLOGIES

Mid-infrared spectrometry (MIR) is a tool which has been around for a long time, and is the method routinely employed by milk recording organisations world-wide to determine the quantity of fat, protein and lactose in milk samples. Milk constituents for an individual or bulk milk sample are determined by shining light through the milk sample at over 1,000 different wavelengths. The absorbance of light through the milk sample is recorded, and the resulting spectrum used to quantify the proportion of fat, protein, and other milk constituents. Moorepark, in collaboration with other European research institutions has embarked on a project to obtain more information from the spectrum, which is routinely generated at least four times annually for over 400,000 milk recorded cows in Ireland as well as all milk bulk tank samples.

The RobustMilk project was initiated with an objective to provide tools to aid breeders to select healthier cows that produce healthier milk. Using the MIR spectrum generated from routine milk recording, equations have been developed which accurately predict the levels of fatty acids in milk (for example the amount of saturated or unsaturated fat in milk) as well as the energy balance of the cow that produced the milk. Both are important because of their link to human and cow health.

Research is also ongoing to quantify other constituents in milk using MIR spectrometry including milk lactoferrin content, minerals in milk, and milking machine detergent residues. If successful, equations could be routinely applied to the routine national milk recording service and the resulting data used to identify genetically elite cows.

THE NEXT GENERATION

Genetic gain is accelerating in Ireland at an ever-increasing pace. With genomic selection of females now a reality, the acceleration in genetic gain within the national herd is set to increase further. An obvious advantage of increased genetic gain is the higher number of higher EBI animals in our herds. However, how can we be certain that selection is going in the correct direction for all traits? Are we confident that we have not missed out on any important traits in the EBI, and that by rapidly accelerating genetic gain, we are not rapidly sending a currently unaccounted for trait in the wrong direction? For example, most dairy farmers will remember the detrimental effect that decades of aggressive selection for milk yield had on fertility of our dairy cows.

Initiation of a "Next Generation Herd" is a research project currently proposed at Moorepark. The herd would comprise 170-180 of the highest genetic merit cows in the country managed alongside a smaller number of cows of current national average genetic merit. The high EBI cows represent the future of our national dairy herd, and detailed observations on these cows for difficult to measure traits such as feed intake, methane emissions and energy balance, amongst others, would be undertaken routinely. The objective of establishing such a sentinel herd is to allow us to monitor trends in all important traits, including the traditionally difficult to measure traits, to ascertain the suitability of the high EBI animal to futuristic management systems, to enhance the development of the EBI and to ensure coordinated and sustainable genetic gain into the future.

TRAITS OF THE FUTURE

Several other animal breeding related research projects are underway at Moorepark. Two separate European collaborative projects, GreenhouseMilk and OptiMIR have just commenced. The objective of the GreenhouseMilk project is to investigate the influence of genetics on environmental footprint in particular greenhouse gas emissions and cow production efficiency. The OptiMIR project is an international project including both Moorepark and the ICBF with the objective of further exploiting MIR and related technology by generating tools that interpret on-going research results into readily and easily usable decision support.

Geneticists at Moorepark also continue to work closely with the ICBF and the dairy and beef industry in providing research for the national genetic evaluations as well as the national breeding programme.

More information on the international collaborative projects mentioned in this article is available from their dedicated websites: *http://www.robustmilk.eu*, *http://www.optimir.eu* and *http://www.sac.ac.uk/greenhousemilk.*

CONCLUSION

The animal breeding research projects currently underway focus on developing and exploiting the best technology available to continually increase long term genetic gain in a sustainable manner.

Jersey crossbreeding at Ballydague

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SUMMARY

- Results from Ballydague have shown that Jersey×Holstein-Friesian cows are at least as productive, have higher intake capacity, are more efficient converters of grazed grass to milk solids and are markedly more fertile compared to Holstein-Friesian cows.
- Ongoing research at Ballydague investigating stocking rate and post-grazing residual effects, to identify the optimum stocking rate for the Holstein-Friesian, Jersey and Jersey×Holstein-Friesian crossbred cows, suggest optimal performance will occur at a stocking rate of less than three cows/ha, grazing to a post-grazing residual of approximately four centimetres.

INTRODUCTION

For the past six years (2006 to 2011), research at the 'Ballydague farm' has focussed on evaluating the merits of crossbreeding with Jersey. While crossbred cows are not the preferred choice of all dairy farmers, it is very clear from the research results emanating from Ballydague that the Jersey crossbred dairy cow will significantly increase dairy farm profit. Going forward crossbreeding with Jersey will make an increasing contribution in light of current and expect policy and the consequent drive by the industry to maximise output/profit per ha and reduce costs. Since 2009, the study at Ballydague is aimed at ascertaining the optimum grazing strategy to maximise profit for each of the three genotypes; Holstein-Friesian, Jersey and Jersey×Holstein-Friesian. Prudent crossbreeding introduces favourable genes from other breeds (complimentarily), and capitalises on heterosis or hybrid vigour. Crossing with the Jersey may be viewed therefore as a means of maximising solids production per hectare, increasing survival, reducing maintenance costs (due to a reduced size) and is particularly complementary to the multiple component milk payment system (A+B-C).

COMPARATIVE PERFORMANCE

The favourable production and reproductive efficiency of the Jersey crossbreds at Ballydague has by now been well documented. Research at Ballydague has highlighted that crossbreeding with Jersey will give a significant improvement to milk composition (+0.7 per cent fat and +0.3 per cent protein), and annual milk solids output (+17 kg) compared to their Holstein-Friesian contemporaries. Reproductive efficiency is also markedly superior with the Jersey crossbred cows (e.g. pregnancy rate to first service +15 per cent, 6 week in-calf rate +14 per cent, 13 week in-calf rate +8 per cent and calving to conception interval -6 days). The fertility performance of the purebred Jersey has been no better than that of the Holstein-Friesian, leading to the conclusion that the superior performance of the Jersey crossbred is largely due to hybrid vigour. Nonetheless the significant improvement in reproductive efficiency, consistently observed at Ballydague, as well as the very favourable production characteristics observed with the crossbred cows is of major practical relevance to Irish dairy farmers. In financial terms, the benefit of crossbreeding with Jersey (first cross) has been determined using the Moorepark Dairy System Model to be worth over €180/cow/lactation compared to the Holstein-Friesian.

FEED EFFICIENCY

Profitable grazing systems require dairy cows that are capable of achieving large intakes of forage relative to their potential milk yields, and therefore able to meet production targets almost exclusively from grass-based systems. Efficient conversion of feed input to product is critical to economic profitability of the dairy production business. Total feed costs account for 80 per cent of the total variable costs associated with production. Therefore, overall farm profit could be increased by improving the efficiency by which cows' convert grazed pasture to milk solids. Considerable resources have been employed at Ballydague with a view to determining the extent to which variation exists among dairy cows for production efficiency and associated traits. The research highlights clear breed differences for both feed intake capacity at pasture and the output of milk solids (fat+protein yield) per unit of energy consumed. Jersey cows consumed 4 per cent of bodyweight in grass DM/day. This compared to 3.4 per cent for the Holstein-Friesian cows and 3.65 per cent for the Jersey crossbred cows. This finding explains the higher productivity (efficiency) also measured with the Jersey and Jersey crossbred cows; 10 per cent more milk solids per unit intake compared to the Holstein-Friesian cows at Ballydague. Research into differences in grazing behaviour and a subsequent detailed anatomical investigation, the latter conducted on cows from the Ballydague study post-slaughter, have elucidated some of the physiological mechanisms underpinning these innate characteristics of the Jersey breed, many of which are inherited to varying extents by the crossbreed.

OPTIMISING GRAZING STRATEGY

With the impending abolition of milk quota there is now increasing emphasis on the maximisation of productivity per unit land area. It is acknowledged that Ireland is ideally placed to take advantage of these policy reforms with its low cost, grass-based production system. Furthermore, research from New Zealand demonstrates that profit per ha is optimised at stocking rates higher than those recommended here to fore in Ireland. The current research programme at Ballydague (2009 to 2011) is focussed on investigating the optimum stocking rate for Holstein-Friesian, Jersey and the Jersey×Holstein-Friesian crossbred cows. At Ballydague the Holstein-Friesian and Jersey crossbred cows are stocked at 2.5, 2.75 and 3.0 cows/ha (closed systems) while the Jersey cows are stocked at 0.25 cows/ha higher at 2.75, 3.0 and 3.25 cows/ha. Pre-grazing herbage yields tend to average 1200, 1300 and 1400 kg DM/ha, and post-grazing sward height is maintained at 3.00-3.5, 3.75-4.25 and 4.5-5.5 cm (Rising Plate Meter) for the high, medium and low stocking rates, respectively. Results to date provide no evidence of a breed group by grazing regime interaction. Milk production per cow (2010 values provided as an example) is reduced in all breed groups at the high stocking (407kg MS/cow) compared to the medium (456 kg MS/cow) and low (468 kg MS/cow) stocking rate treatments. Preliminary analyses suggest that optimal productivity per ha will be obtained at a stocking rate of less than 3 cows/ha, consistently grazing to a post-grazing residual of approximately four centimetres.

CONCLUSIONS

The results being obtained from the research at Ballydague clearly indicate very favourable performance is achievable with Jersey×Holstein-Friesian cows. Optimum productivity is expected to be achieved at a stocking rate of less than three cows/ha, grazing to post-grazing residual of approximately four centimetres.

Norwegian Red – another viable option

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SUMMARY

- In Ireland there is need for an easy care cow that produces a large amounts of milk solids from grazed grass and maintain a 365 day calving interval.
- Crossbreeding is one option that may assist dairy farmers overcome the antagonisms (reduced fertility and survival performance) of past selection.
- Based on research findings from a large on-farm study conducted by Moorepark, milk production was found to be similar for the Norwegian Red × Holstein-Friesian compared to the Holstein-Friesian; this was coupled with superior reproductive efficiency and udder health.
- Preliminary economic analysis indicates that the Norwegian Red × Holstein-Friesian was €130 more profitable per lactation compared to the Holstein-Friesian contemporaries.

INTRODUCTION

To allow expansion to be a viable option for dairy herds in the current economic climate, animal management must be kept to a minimum. Thus, the dairy cow needed for the future must be an “easy care” animal. This cow must be capable of producing large quantities of milk solids from a finite land base and also maintain a 365 day calving interval. This is one of the greatest challenges facing dairy farmers, as past selection for milk yield has had a negative effect on dairy cow fertility. Calving intervals of 365-370 days and culling rate for infertility of less than 10 per cent are required for optimal financial performance within a seasonal dairy system. In an attempt to overcome this problem, traits such as fertility, health and calving are now included in the Economic Breeding Index (EBI). Gains from within breed selection will inevitably take a number of generations to have a significant impact. Recent studies from both Moorepark and abroad, suggest that crossbreeding may provide a “quick fix” solution to many of the antagonisms of past selection where high genetic merit ‘alternative breed’ sires are used.

FUNDAMENTALS OF CROSSBREEDING

The primary aims of a successful crossbreeding strategy are: 1) the introduction of favourable genes from another breed selected more strongly for traits of interest, 2) to remove the negative effects associated with inbreeding depression, and 3) for many traits to capitalise on what is known as heterosis or hybrid vigour (HV). Because of HV crossbred animals usually perform better than that expected based on the average of their parents. Hybrid vigour will generally be higher in traits related to fitness and health i.e. traits which have lower heritabilities are more difficult to improve via within breed selection.

ON-FARM PARTICIPATORY STUDY

An initial study carried out at the Ballydague research farm demonstrated that the Norwegian Red (NR) breed had a slightly lower milk yield capacity, but exhibited superior udder health and reproductive efficiency compared to Holstein-Friesian cows. To affirm the findings from Ballydague which were obtained with a relatively small number of cows, a large farm participatory study involving 50 commercial dairy herds was established. Another function of this large scale study was to generate sufficient data to be used by the Irish Cattle Breeding Federation to produce EBIs for NR cattle. All of these herds were milk recorded and detailed fertility, body condition score and live weight data was collected for three years. This study ran from 2006 to 2008. In order to enhance this data set, performance data (spanning 2006 to 2010) from over 100 additional herds containing both HF and NR genetics were identified from the national data base and incorporated into the data analysis.

ANIMAL PERFORMANCE

The performance results are presented in Table 1. The performance of the NR×HF cows is impressive. While 305 day milk, fat and protein yields were lower for the NR that of the NR×HF was very similar to the HF. The benefits of the NR were evident in traits such as fertility and udder health.

Preliminary economic analysis based on genetic differences observed between the breed groups (details not presented) and the economic values used in the EBI, indicate superior profit (per lactation) for NR×HF (+€130) compared to the pure Holstein cows, equating to approximately +€13,000 more profit annually in a 40 ha farm. Much of this is due to the increase in fertility/survival associated with these cows compared to the HF.

Research from Teagasc Grange has confirmed that the beef merit of NR×HF male progeny is similar to that of straight HF.

Table 1. 305 day milk production, somatic cell count and fertility performance for HF, NR and NR × HF

Milk Production Traits	HF	NR	NR x HF
Milk	6464	5977	6269
Fat %	3.94	3.93	3.93
Fat (kg)	253	235	246
Protein %	3.47	3.49	3.50
Protein (kg)	223	209	219
SCC (1000 cells/ml)	165	131	132
Fertility traits (on-farm study herds only)			
Pregnancy rate to 1st service (%)	49	56	57
Pregnancy rate after 6 weeks breeding (%)	56	67	67
Preg rate after 13 weeks breeding (%)	83	89	88
Calving to conception interval (days)	86	84	82
Number of services	1.72	1.57	1.57

NEW THREE-WAY-CROSSBREEDING STUDY

The positive outcome of the on-farm Norwegian Red study has prompted the use of Norwegian Red sires on the Jersey Crossbred cows at Ballydague. The first crop (n=16) of resulting 3-way-crossbred heifers are now in first lactation. While it is too early to draw conclusions their initial performance results are favourable.

CONCLUSIONS

Data generated by Moorepark has established a favourable outcome from crossbreeding with Norwegian Red. Herd production potential is not expected to decline, while udder health reproductive efficiency and survival is expect to improve markedly.

Variation in dairy cow feed efficiency amongst breeds

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SUMMARY

- In Irish grass-based dairy production systems cows must be capable of achieving a high intake of grazed grass per unit live weight and a high yield of milk solids per unit intake, without negative consequences on longevity.
- A study comparing Holstein-Friesian, Jersey and Jersey×Holstein-Friesian cows showed that Jersey cows had the highest intake per unit live weight and the highest milk solids production per unit intake.
- For their size the Jersey and Jersey×Holstein-Friesian cows had a larger gastrointestinal tract than Holstein-Friesian cows.
- Cows with good feed efficiency characteristics, such as Jersey and Jersey×Holstein-Friesian cows, are well suited to the Irish grass-based dairy production system.

INTRODUCTION

With the abolition of quotas clearly on the horizon, the necessity for Irish farmers to remain competitive is absolute. Grass utilisation and increasing the proportion of grass in the diet of the dairy cow are strongly linked to increased profitability. Some cows are more suited to this grass-focused production system than others. In Irish grass-based systems, cows must be capable of achieving a high intake of grazed grass per unit liveweight. This is known as high intake capacity. In addition to this the cows must have high production efficiency. This means that they must be capable of producing a high yield of milk fat and protein for every kilogramme of feed that they ingest. This latter ratio is also known as feed conversion efficiency. In grass-based systems both high intake capacity and high production efficiency are desirable, along with cow longevity in the herd.

DIFFERENT COWS HAVE DIFFERENT EFFICIENCIES

A large body of work has been undertaken over the last number of years at the Teagasc Moorepark Ballydague Research Farm. Three breeds of dairy cow, namely Holstein-Friesian (HF), Jersey (J) and their cross (J×HF), are being investigated in terms of both their overall performance and their efficiency.

This study demonstrated that Jersey cows had the highest production efficiency and the highest intake capacity, with dry matter intake measured at 4.0 per cent of liveweight. The HF cows had the lowest production efficiency and the lowest intake capacity, with dry matter intake measured at 3.4 per cent of liveweight. At 3.6 per cent, the intake capacity of J×HF cows was intermediate to the two parent breeds. Thus the intake capacity of HF cows was 10 per cent lower than that of the Jersey and J×HF cows. In general, cows with high intake capacity tended to be smaller than contemporaries with low intake capacity. A high intake capacity by cows was shown to be related to a high rate of intake per unit liveweight and an increased grazing time per unit liveweight. These high intake capacity cows could therefore be described as 'aggressive' grazers. The high production efficiency was related to a high rate of grazing mastications. So these high production efficiency cows chewed the grass while grazing more than their low production efficiency counterparts. Again, these high production efficiency cows demonstrated the 'aggressive grazer' characteristics. This study suggests that eating and ruminating behaviour differs between the different breeds of dairy cows, and this behaviour is key to how suited the animal is to a grass-based dairy production system. It was interesting to note that the crossbred J×HF cow demonstrated hybrid vigour for some of these behaviours, indicating their suitability to grass-based production systems. The reason for these breed behaviour differences was not clear, but it was suggested that differences in the size of the gastrointestinal tract (GIT) might be responsible.

As a result last year a further study was conducted. Cows representing the three breeds were slaughtered and the weight of the different components of the GIT were measured. The GIT is made up of the stomach and the intestines. Of course in a cow, as in any ruminant, the stomach contains four parts, namely the rumen, reticulum, omasum and abomasum. The tissue weights were compared between the different breeds of cow. We found the GIT tissues from Jersey cows weighed less than the GIT tissues from HF and J×HF cows. This was expected, as Jersey cows are smaller in size than the other two breeds. In order to compare the tissues on a like-for-like basis we expressed the tissue weights as a proportion of the cow liveweight, and then again compared the different breeds. This time we found that, on a proportion of liveweight basis, the HF cow had the smallest GIT tissues (Figure 1).

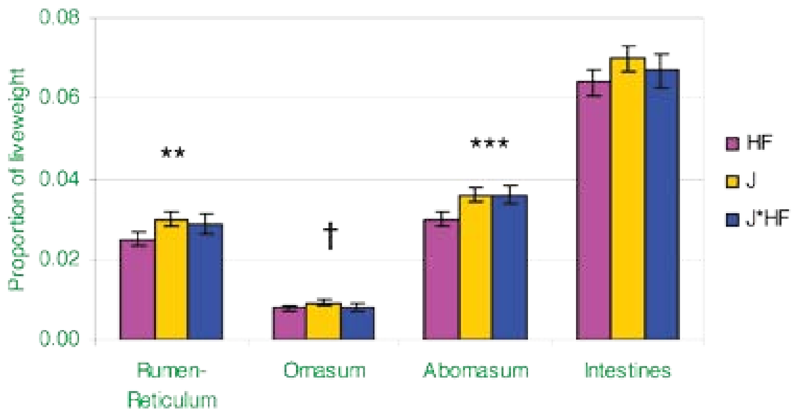

Figure 1. Stomach (rumen, reticulum, omasum and abomasum) and intestinal weights, expressed as a proportion of liveweight, in three breeds of dairy cow, namely Holstein-Friesian, Jersey and Jersey×Holstein-Friesian

This means that for their size the Jersey and J×HF cows had a proportionally larger GIT than the HF cows. The relatively greater-sized GIT explains why the Jersey and J×HF cows had a greater intake capacity than the HF cows. For their size there is simply more room to take in, store and digest feed.

CONCLUSIONS

Cows that can make maximum use of grass are key to the success and profitability of Irish grass-based dairy production systems. Variation in the two desirable traits: intake capacity (ability to consume grass relative to their liveweight) and production efficiency (ability to convert grass dry matter intake to milk solids) has been shown to exist. Cows with a greater intake capacity have a larger GIT relative to their body size so physically have the capability to consume more.

Modelling milk processing

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SUMMARY

- Modelling both farm and milk processing targets maximum overall industry profitability.
- Increasing milk solids concentration and earlier mean calving date will result in higher returns for processors and farmers alike.
- Farm bio-economic models in conjunction with milk processing models will be very beneficial in the future in developing milk pricing systems.

INTRODUCTION

Decisions that are taken in the industry should be made with the objective of increasing the profitability of the industry as a whole. Models that simulate farm level activities and milk processing can be used to guide the decision making process. The Moorepark Dairy Systems Model is extensively used at Moorepark to examine physical, biological and technical changes at farm level to answer questions within the farm gate. In order to simulate the milk processing sector a model of the sector is currently being developed. These models together describe a large proportion of the dairy industry and allow various strategies within the dairy industry to be investigated/simulated. Uses of the industry model when completed will be to develop strategies that will facilitate expansion in the most profitable fashion guiding the decision making process on issues such as seasonality, product mix, milk pricing, requirements for capacity and optimum locations for expansion.

MOOREPARK DAIRY SYSTEMS MODEL

This model simulates dairying systems inside the farm gate accounting for the physical, biological and technical dimensions of the farm. Stock numbers and valuation, milk production, feed requirements, land and labour requirements are included in the model. Examples of how the model has been used include: comparisons of breeds/crossbreeds, the cost of mastitis, the impact of stocking rate, calving date or grazing season length, the Economic Breeding Index, the Grass Economic Index, the carbon footprint of dairy products, etc.

MOOREPARK PROCESSING SECTOR MODEL

This model is being developed to mimic the activities of a milk processor. The model takes account of all inputs, outputs, and losses involved in the conversion of milk to dairy products. Within the model the production of cheese, butter, whole milk powder, skim milk powder and fluid milk is simulated. The volume and composition of raw milk intake, products produced and the associated composition are included as model inputs. The quantities of products and by-products that can be produced from the available milk pool, to meet product specifications, are calculated. Processing costs are simulated, the net return from raw milk is calculated and the values per kg of fat, per kg of protein, carrier costs per litre and milk price per litre are calculated in the model. Two applications of the processing sector model are provided by way of example; the first with regard to milk composition and the second with regard to seasonality within the Spring calving system.

Milk composition This model has been used to examine the impact varying milk composition has on the volume of products produced, net returns, the value per kg of fat and protein and milk price. Three milk compositions representing (i) national average Holstein-Friesian (HF); 3.83 per cent fat and 3.34 per cent protein, (ii) Jersey (J); 5.33 per cent fat and 4.06 per cent protein, and (iii) high milk composition Holstein-Friesian (HHF); 4.30 per cent fat and 3.50 per cent protein, were simulated in the model. The product mix was representative of the 2008 national product mix with 43, 30, 14 and 13 per cent of 1,000 l of milk processed into cheese, butter, whole milk powder and skim milk powder, respectively. The product market values used in the model were representative of a three year average (2008-2010). The model estimated the value per litre of milk to be 26.1, 32.6 and 28.0 cents for HF, Jersey and HHF milk, respectively. For HF, Jersey and HHF a kg of fat was estimated to be worth €2.16, €3.40 and €2.63, respectively. The corresponding protein values were €6.14, €4.21 and €5.51, respectively. Multiplying the value per kg of fat by the kgs of fat in 1000 l of the milk, and the value per kg of protein by the kgs of protein in the milk, less transport costs, results in net returns of €261, €326 and €280 for HF, Jersey and HHF milk, respectively. Jersey milk yields higher net returns because of its high solids content. The methodology used in this analysis to estimate the fat and protein values is called the marginal rate of technical substitution. This method quantifies the effect on net returns of replacing 1 kg of fat with protein and vice versa. From this the price of 1 kg of fat relative to the price of 1 kg of protein, subject to the net returns remaining constant, is calculated. In this analysis the value per kg of fat is higher for Jersey milk than HF and HHF because Jersey milk has a higher fat percentage, therefore more butter is produced using Jersey milk. Fat has a higher value in butter than in cheese. Using the marginal rate of technical substitution, once the value of fat increases the relative value of protein must decrease. In HF and HHF milk the relative fat and protein values are similar because the fat to protein ratios are closer relative to the Jersey milk ratios. This analysis shows there are potential gains in net returns and milk price in the region of 25 per cent to be made from improving milk composition.

Calving date The model has also been used to examine the impact of a change to the national mean calving date on processor returns and milk price. Two milk supply profiles representative of mean calving dates of February 15th and March 14th (national mean calving date) were evaluated, assuming the national milk supply of 5,189.9 million (m) litres per annum. There was a limit placed on the processing capacity of both cheese and casein similar to the national situation. The February 15th mean calving date resulted in a lower peak supply with proportionately more milk being produced at the shoulders (February to April and September to November). The February 15th supply profile resulted in a larger volume of milk going towards cheese and casein production relative to the March 14th supply profile. This resulted in higher net returns of €1,550.8 m relative to €1,564.0 m and a higher average milk price of 0.5 cents/litre, thus highlighting earlier calving is more profitable. This finding is complemented by the estimated gains at farm level of approximately 0.16 cents per litre by moving the mean calving date earlier as demonstrated using the Moorepark Dairy Systems Model.

CONCLUSION

Decisions made in the Irish dairy industry should be taken in the context of maximising overall industry profitability (farmer and processor). Models of both sectors can be used to help this decision making process. This research has shown that there are significant benefits possible at processor level from increasing milk composition and having earlier more compact calving, which have been previously demonstrated at farm level.

Genetic merit for fertility traits and effects on cow performance

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SUMMARY

- Herd fertility is a key determinant of farm profit.
- Large variation in genetic merit for fertility traits exists within the national herd.
- An on-going trial at Moorepark has clearly demonstrated that cows with poor genetic merit for fertility traits have substantially lower fertility performance compared with cows with high genetic merit for fertility traits.
- It is essential to use high EBI sires with a strong fertility sub-index.

INTRODUCTION

For seasonal calving herds, good herd fertility is essential to achieve compact calving to coincide with the resumption in grass growth, which in turn is a key driver of farm profit. For this reason the fertility sub index is the single biggest contributor to the EBI (34.8%). In a non-quota scenario; achieving good fertility performance and a compact early calving pattern will favourably impact on farm profit by:

- » Maximising labour efficiency in expanding herds; compact calving, calf-rearing and breeding season.
- » Increased milk solids output per cow; longer lactations, and more mature cows that have greater production potential.
- » Increased milk solids produced from grazed grass (cheapest feed source).
- » Avoid peak milk production penalties (May/June) and avail of shoulder production bonuses (starting with Glanbia in 2012, others likely to follow)
- » Reduced incidence of costly interventions; less non-cyclic cows, phantom cows, hormonal treatments, etc.
- » Reduced empty rates, less involuntary culling, more scope for voluntary culling for cell count, lameness or poor production.
- » Lower replacement rate and hence greater scope for expansion.

STUDY COMPARING COWS WITH HIGH AND LOW FERTILITY SUB-INDEX

In 2008 a study was established at Moorepark to investigate the reproductive efficiency of two lines within the Holstein-Friesian breed with contrasting genetic merit for fertility/survival but with similar genetic merit for milk production. This study was established to identify the physiological reasons for poor fertility. With the aid of the ICBF, the national database was screened for in-calf Holstein-Friesian heifers (animals with New Zealand Friesian genetics were excluded from selection) with similar genetic merit for production traits (average Milk kg = +249 kg), but with extremes of high (average Calving Interval = -3.2) or low (average Calving Interval = +2.93) genetic merit for fertility traits. A total of 36 heifers due to calve in spring 2008 were purchased and moved to the Moorepark farm. All 36 cows had a similar percentage of Holstein-Friesian genetics (93%) and similar values for the milk production sub-index (€40). The 18 High Fertility sub-index heifers had a fertility sub-index of €51 and an overall EBI of €105 and the remaining 18 had a fertility subindex of €-30 and an overall EBI of €6. The mean calving date was the 18th of February for the High Fertility cows and the 9th of February for the Low Fertility cows. All 36 cows are managed as one herd in accordance with the Moorepark blueprint for pasture-based milk production and cows were inseminated with frozen thawed semen at standing heat.

There was no difference in milk production, during their first lactation. Both groups yielded just over 360 kg milk solids/cow. The High Fertility group maintained higher BCS throughout lactation (2.81 vs. 2.65). No difference was seen in the total dry matter intake measured at three time points during lactation (15.20 vs. 15.14 kg/day).

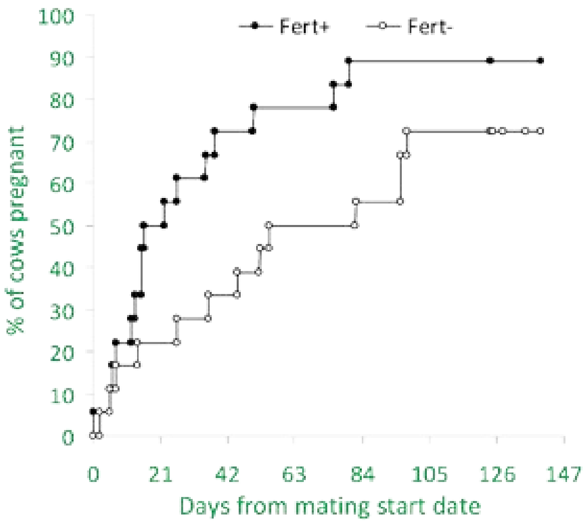

Figure 1. Days from mating start date to pregnancy in the High and Low Fertility herds during Year 1 of the study (all 1st lactation)

The breeding season started on 14th April (day 0), and the High Fertility cows (closed black circles) successfully established pregnancy quicker than the Low Fertility cows (open white circles). The contributing factors driving this large difference in fertility, were the High Fertility cows having a higher submission rate (83 vs. 72%), better conception rates to first service (56 vs. 28%), and a lower overall empty rate (11 vs. 28%) compared to the Low Fertility group. All the above fertility measures can be condensed into a single pivotal point. Mean calving date in 2009 for the High Fertility group was similar to 2008, but slipped by a month in the Low Fertility group. As a result, the High Fertility group exhibited a more compact calving pattern and longer lactations, resulting in a more profitable cow.

Progesterone is known as the "the hormone of pregnancy". Blood concentrations of progesterone were measured daily for a full oestrous cycle in all cows. Progesterone concentrations were greater in the High Fertility group during the first 16 days of the cycle compared to the Low Fertility group. This suggests that elevated progesterone results in a more favourable uterine environment to support pregnancy in the High Fertility cows. On-going research is investigating this topic.

CONCLUSIONS

Currently the Active bull list has 42 bulls with a fertility sub index greater than €100 and an EBI reliability ranging from 39 to 91 per cent. A high reliability sire with a fertility sub-index greater than €100 will generate replacement heifers with superior genetics for fertility traits. Importantly, this can be achieved without reducing production potential; in fact, cow productivity is increased through earlier calving, longer lactations and survival of more cows to maturity. Ongoing and future work with these cows will help to increase our understanding of the reasons for poor fertility, and potentially identify markers that could be included in selection indexes.

Oestrus and ovulation synchronisation protocols to improve submission rates

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SUMMARY

- Achieving a compact calving pattern is essential to maximise profitability.
- Poor submission rates arise from poor heat detection efficiency and high proportions of non-cycling cows within the herd.
- Ovulation synchronisation protocols permit the use of fixed timed AI, whereby cows are inseminated without reference to standing heat, resulting in 100 per cent submission rate.
- For herds with a spread out calving pattern or herds with a later than desired mean calving date, synchrony may help to concentrate the calving pattern.

INTRODUCTION

Compact calving is and will be a key driver of efficiency and productivity within the Irish dairy industry. Maximising submission rates during the period of AI use will increase the proportion of the herd conceiving to high fertility, high EBI AI sires, thereby accelerating herd genetic gain.

HORMONAL PROTOCOLS TO SYNCHRONISE OESTRUS AND OVULATION

A Moorepark study, completed on 8 commercial dairy farms in 2008, examined the effects of using synchronisation on herd fertility performance. Herds were visited on 3 occasions during the breeding season. The synchronisation treatments facilitated AI on mating start date (MSD) for cows that were calved at least 42 days at MSD. A second round of synchrony was carried out 3 weeks later for cows that were calved 42 days or more at 21 days into the breeding season. A final round of synchrony was carried out 3 weeks later for cows that were calved 42 days or more at 42 days into the breeding season. The synchronisation treatments are outlined in Table 1.

Table 1. Hormone schedule for the different synchrony treatments

	CIDR-OBS	CIDR-TAI	OVSYNCH	CONTROL
Day -10 (AM)	GnRH + CIDR in	GnRH + CIDR in	GnRH	-
Day -3 (AM)	$PGF_{2\alpha}$ ↓ 24 h	$PGF_{2\alpha}$ ↓ 24 h	$PGF_{2\alpha}$ ↓ 60 h	-
Day -2 (AM)	CIDR out	CIDR out ↓ 36 h		-
Day -1 (PM)	-	GnRH ↓ 18 h	GnRH ↓ 18 h	-
Day 0 (AI/heat)	AI at observed oestrus	Timed AI	Timed AI	AI at observed oestrus

Drugs used on experiment: GnRH = 2.5 mL Receptal i.m.; $PGF_{2\alpha}$ = 5 ml Lutalyse i.m.; CIDR 1.38 g P4

CIDR-OBS was an oestrous synchronisation treatment, and cows had to display behavioural oestrus before being bred. Timed AI protocols facilitated AI at a fixed time with no requirement for heat detection (CIDR-TAI & OVSYNCH). The timed AI treatments were associated with earlier conception after the commencement of the breeding season. This occurred as a result of higher submission rates and shorter intervals to first service.

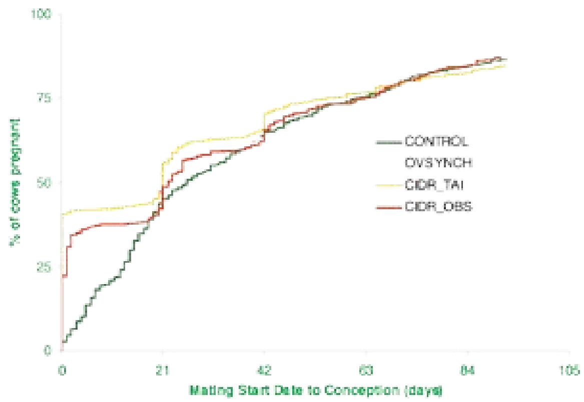

Figure 1. Pattern of pregnancy establishment for cows treated with protocols to synchronise oestrus and ovulation

From MSD (Day 0) the percentage of CONTROL cows successfully establishing pregnancy increased rapidly for the first 3 to 5 weeks, and then continued to increase at a gradual pace until the end of the breeding period (Figure 1). In contrast, for animals assigned to synchronisation treatments, a large proportion of animals became pregnant on the first day of the breeding season, followed by two further sharp increases at the second and third rounds of synchrony at 21 and 42 days into the breeding season, respectively. This was most pronounced for CIDR-TAI. There was no difference between treatments in the proportion of cows pregnant at the end of the breeding season. The use of synchronisation protocols was associated with shorter intervals from the mating start date to conception, and thus an earlier calving pattern in the following season. The results for six week incalf rate were: 71.0 per cent, 75.0 per cent, 71.0 per cent, and 67.0 per cent for CIDR-OBS, CIDR-TAI, OVSYNCH, and CONTROL, respectively. The median days from mating start date to conception for CIDR-OBS, CIDR-TAI, OVSYNCH and CONTROL were 33, 31, 32 and 37 days, respectively.

CONCLUSION

Achieving a concentrated calving pattern requires a high pregnancy rate within a short period following the planned start of mating. It is not possible to achieve a high six week in-calf rate without having good submission rates, and this in turn is dependent on heat detection efficiency. Timed AI protocols were associated with earlier conception after MSD due to higher submission rates, shorter intervals from mating start date to breeding, and thus a greater proportion of animals successfully establishing pregnancy during the first 42 days of the breeding season. For herds with a spread out calving pattern or herds with a later than desired mean calving date, whole-herd synchrony may be a useful tool to concentrate the proportion of the herd calving early in the following spring.

Calving management and calf care for the next generation

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SUMMARY

- Supply adequate levels of minerals and vitamins during the dry period
- Supervise, but don't unnecessarily intervene, during calving
- Be present to resuscitate a weak calf, dress its navel and feed it colostrum
- Researchers at Moorepark are currently working with dairy farmers to understand why some farmers lose more calves than others and what they can do to rectify this

INTRODUCTION

Calving is the most hazardous period in the life of the calf. As more emphasis has been placed on getting cows in calf we have lost sight of the fact that it is equally important to get them all out alive. Recently a new research programme has commenced at Moorepark in collaboration with commercial dairy farmers looking at calf losses around calving. Some 90 per cent of calves which die around calving were alive at the start of calving and so much of this loss is preventable. While some farmers only lose the odd calf, others lose up to 25 per cent of their calves and many farmers underestimate the true extent of their losses. If you want to know where you stand on your calving performance, the Calving Statistics Report of HerdPlus® (www.icbf.ie) provides an excellent summary of your calving records highlighting your performance compared to the national average.

NEW RESEARCH WORK AT MOOREPARK

In collaboration with commercial dairy farmers, researchers at Moorepark, linked to the Department Vet Labs in Cork and Backweston have recently commenced a research programme looking at calf losses around calving. The objective of the study is to investigate dairy herds with and without problems to see can we understand better why loss rates vary so much between herds and ultimately what farmers can do about this. This study will yield up-to-date information of immediate relevance to all dairy farmers, especially those with problems around calving.

FAIL TO PREPARE – PREPARE TO FAIL!

You can reduce your calf losses long before the first calf hits the ground next autumn or spring. Research at the Moorepark Post-Mortem Laboratory in Spring 2011 has found that infections turned up in 10 to 15 per cent of dead calves. So have a chat with your vet now about whether you need to revise your BVD, Salmonella, Neospora and Lepto herd health programmes before the next calving season begins. Having heifers and autumn-calving cows in too fat body condition before calving is still causing problems resulting in 10 to 15 per cent of calves dying during slow calvings where the heifer or cow does not open up fully. Aim for a body condition score of 2.75 to 3.25 at drying off and 3.0 to 3.5 at calving. Restrict the diet if necessary before calving down. In addition to condition score problems, 5 to 15 per cent of calves are still dying from trace element imbalances even on well run dairy farms. It is worth reviewing your current nutritional management of the pregnant stock, particularly if you out-wintered them on brassicas, e.g. kale.

If you are unsure about what the trace element status of the spring-calvers will be you can establish this by having your local vet bleed 5 heifers and 5 cows in October/ November.

Figure 1. Prolonged calvings result in calves dying during birth due to lack of oxygen

YOU'RE THE MIDWIFE!

Once the calving season begins you can have a major influence on the outcome of each calving. In recent years with the move to group calving units, whether outdoors on woodchip or indoors on straw, scraping off or re-bedding has become even more important to prevent losses from early scours and navel/joint ill. Ideally move pregnant animals into the calving unit before they start to calve or if they have already started to calve leave them till they have the crubes showing as this results in less problems. With herds expanding in size and labour scarce there is a trend now towards less time spent watching cows at calving. Most calvings don't need any assistance and this reduces the risk of metritis. However, some cases do need help, typically calves presented abnormally. In the post mortem lab 20 to 25 per cent of the calves we see came backwards or with legs down at calving. Of these a quarter had fractured ribs or a fractured spine. All were pulled out with a calving jack. The trick to preventing these fatal injuries is to call the vet early if you're not sure you can get the calf out alive or to be careful with how acutely you pull the jack downwards before the chest comes out.

Figure 2. One in six calves dying at calving have calving jack injuries such as fractured ribs, legs or spine.

CARE OF THE NEWBORN CALF

Some 35 per cent of the calves we examined post mortem had partially inflated lungs indicating they had breathed but not fully inflated their lungs. If these calves have no other injuries they can be saved by prompt resuscitation. Firstly you need to be there for these 'at-risk' calves. First aid that works includes pouring cold water into the calf's ear, suspending it upside down (for about a minute maximum), sitting it upright and using resuscitating drops/gels or oxygen if available. Once you're happy the calf is breathing normally dress the navel and feed it biestings. While some farmers have no problems without navel care, if your calving pen hygiene and colostrum management is poor, drench the navel from a squeeze pottle with an antiseptic solution.

SAFETY AT CALVING

Every year farmers are attacked by recently calved cows; 25 per cent of farm accidents and 20 per cent of farm deaths in older farmers are livestock-related so keep your wits about you.

CONCLUSIONS

Calf losses occur even on well run dairy farms. To reduce your losses 1) supply adequate levels of minerals and vitamins during the dry period, 2) supervise, but don't unnecessarily intervene during calving, and 3) be present to resuscitate a weak calf, dress its navel and feed it colostrum.

Rearing the next generation

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SUMMARY

- Ensure calves receive two to three litres of colostrum within 4 hours of birth – absorption of antibodies reduces over time so the earlier the better.
- Calves can be reared outdoors and achieve weight gains similar to those reared indoors.
- Calves should be weaned by weight to ensure a uniform group.

INTRODUCTION

An efficient calf rearing system is crucial. Most farmers are familiar with the following scenario – calving starts and there are no problems with the calves for the first five to six weeks, but once the peak of calving has passed and a lot of calves have been through the calf house problems begin to start. Unfortunately there are no 'quick fix' solutions, the key to rearing good quality calves is getting the basics right. While this may take time and effort initially, it should reap dividends in the form of healthier, stronger calves.

COLOSTRUM

Research has shown that colostrum management is the single most important management factor in determining calf health and survival. Colostrum (biestings) is the cow's first milk after calving. It contains antibodies and growth factors and is superior in nutritional value compared to whole milk. A failure of passive transfer of antibodies from colostrum contributes to excessively high pre-weaning mortality and morbidity rates.

Absorption of antibodies by the calf is greatest in the first few hours of life. It starts to decline progressively after four to six hours and ceases after 24 hours from birth. Therefore, it is critical to feed colostrum as soon as possible after calving to ensure maximum immunity is acquired.

Ideally calves should be given two to three litres of colostrum by stomach tube or by nipple feeding within four hours of birth. Research has shown that absorption of antibodies is greatest with a stomach tube due to the correct volume of colostrum being ingested by the calf. Leaving calves to suckle colostrum from their dam is not recommended as there is no guarantee that they will have a sufficient intake.

HOUSING

Expanding dairy herds often overlook the provision of additional infrastructure for calf rearing during the expansion process. Building new calf houses can be expensive, especially as they are limited to use during the months of calf rearing. Consequently alternative options have been investigated at Teagasc Moorepark. The experiments completed determined that calves turned out at two to three weeks old could be reared without compromising weight gain and vitality compared to calves reared indoors during the milk feeding period. However, it is deemed necessary to provide overhead shelter from wind and rain for all calves outdoors.

Three housing systems were compared at Moorepark: i) indoors, ii) outdoors with low cost roofed shelters (Figure 1a) and iii) outdoors with straw bale shelters in a cross or 'X' shape (Figure 1b). Calves went to grass at approximately three weeks old – if, however, calves became ill or were showing signs of ill-thrift outdoors they were brought back in and treated, they were returned outdoors post recovery.

Daily weight gain from birth to weaning was higher for the group of calves reared outdoors (0.54 kg/calf/day) compared to those reared indoors (0.48 kg/calf/day). Number of treatments administered was lowest in the shelter treatment (one treatment) compared with the indoors and straw treatments (11 and 6 per cent, respectively). Interestingly, it was clear from this experiment that pre-weaning treatment affected post-weaning weight gain: weight of the outdoor reared calves tended to be higher (+9 kg) 72 days after mean weaning date.

Figure 1. a) Low cost roofed shelter – with ventilation holes and a raised wooden floor.

Figure 1. b) Straw bale shelter – used as a wind breaker for calves

WEANING WEIGHT

As milk feeding is one of the more labour intensive tasks associated with rearing calves, there may be a temptation to wean calves at an early age. Calves are generally weaned by age or weight. In a recent experiment at Teagasc Moorepark calves were weaned at either 8, 10 or 12 weeks of age. The preliminary results show that calves weaned at eight weeks old were still very light at weaning (58 kg – HF and JEX calves). Although calves weaned at 12-weeks of age consumed 126 litres more milk compared to the eight week weaned calves, they were 19 kg heavier at weaning. Weaning at this heavier weight ensured healthier calves with greater vitality and less requirement for concentrate over the summer.

CONCLUSION

Making certain that calves are given two to three litres of colostrum before they are six hours old is essential to ensure healthy calves and lower levels of mortality. Outdoor calf rearing is a viable alternative for those with insufficient housing or health issues, however overhead shelter is required. Calves should be weaned at a heavier weight (10 – 12 weeks old) as this will result in more vigorous growth rates over the summer months.

The importance of target weight when rearing heifers

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SUMMARY

- Heifer rearing needs to receive high priority
- Bodyweight and body condition score are of greater importance at mating start date than age
- Winter feeding treatment significantly affect the attainment of target weight at mating start date
- Silage only diets during winter do not support sufficient levels of weight gain
- Weight gains are generally high post turnout thus heifers should be turned out to grass as early as possible in spring

INTRODUCTION

Optimum performance from the dairy herd is influenced by realising target weights at key points during the rearing of replacement heifers. Generating well grown, well reared heifers, particularly at mating start date (MSD) can meet the demands for both replacement and expansion. In practice heifer rearing receives low priority on Irish dairy farms and achieving target weights is neglected by many. Reduced levels of management will result in a lesser profit, as heifers may calve later than 24 months, be underweight and produce less milk compared to better managed heifers.

TARGET WEIGHTS

Bodyweight (BW) and body condition score (BCS) are of greater importance at MSD than age. Recently a Moorepark study gathered BW and BCS information at MSD from over eight hundred and seventy Holstein-Friesian (HF) heifers on 48 farms across the country. It was clear that age (i.e. calving at <24 months) does not effect calving date, survivability or subsequent milk production performance. Heifers that achieve target weight at MSD were more productive and are more likely to survive to 2nd and 3rd lactation, and ultimately result in greater profitability. Thus, ensuring maiden heifers achieve target weight at MSD is of critical importance. Every heifer rearing program should have a target BW or proportion of mature BW at MSD. At Moorepark, studies have shown that heifers should be mated at 55 to 60 per cent of mature BW should calve at 85 to 90 per cent of mature BW. A further target of 30 per cent of mature BW at 6 months of age can also be set. Based on this research target BW at three critical periods are outlined in Table 1 for the more popular dairy breeds.

Table 1. Body weight targets for maiden heifers at 6 months, breeding and pre-calving

	HF	NZFR*HF	NR*HF	J*HF
6 month BW (kg)	170	170	170	150
Maiden heifer BW (kg)	330	330	339	295
Pre-calving BW (kg)	550	550	550	490

HF = Holstein-Friesian, NZFR = New Zealand Friesian, NR = Norwegian Red, J = Jerseys, BW -Body weight

WINTER FEEDING OPTIONS

Diet during the first year of life and turnout date in their second year has a large effect on the attainment of target weight at MSD. Ensuring the optimum development of replacement heifers is critical and needs to be accomplished at low cost without sacrificing performance. Traditionally, grass silage based diets have been offered over the winter period however, forage crops can offer a successful alternative to farmers that are expanding their dairy enterprises as the requirement for additional housing is reduced. The feed costs associated with kale are over 30 per cent less than grass silage. Although, it should be noted that forage crops are more suited to drier soil types and require a higher level of both crop and animal husbandry. Over the past two winters experiments have been completed at Teagasc Moorepark to investigate the effect of over-winter diet on the weight gain and BCS of replacement dairy heifers. Indoor and outdoor systems of wintering were compared. The indoor diets focused on silage only or silage and 1.5 kg concentrate. Heifers assigned to the outdoor treatments were offered either a 70 per cent kale and 30 per cent grass silage diet or a 100 per cent kale diet.

Silage only diets (<70% DMD) resulted in weight gains of only 0.3 kg/heifer/day. When heifers were housed indoors and offered grass silage (<70% DMD) plus 1.5 kg concentrate daily weight gains were over 0.4 kg/heifer/day. Heifers that were wintered outdoors (70% kale and 30% silage; 100% kale or offered grass silage (~75% DMD) plus 1.5 kg concentrate/day on an out wintering pad) gained approximately 0.5 kg/heifer/day. The heifers with the higher weight gains over the winter were heavier at MSD than those with poorer weight gains. When heifers were turned out to grass the following spring weight gains from turnout to MSD ranged from approximately 1 kg/heifer/day when grass was in plentiful supply (post-grazing height (PGH) 4cm) to 0.75 kg/heifer/day when grass was in scarce supply (spring 2010; PGH <3.5cm). It is clear that weight gains from grass were significantly higher than those achieved during the winter period. Thus, early turnout is a very important component of achieving target weights at MSD.

COMPENSATORY GROWTH

Compensatory growth is when animals that have been nutritionally restricted increase their growth rate and maintain it for long enough to catch up completely to their contemporaries that have been unrestricted. Frequently, farmers depend on compensatory growth following the first winter for higher weight gains in early spring and the attainment of target weight. However, from the two years of studies completed at Teagasc Moorepark it is clear that compensatory growth should not be relied upon. In the first year of study the grass silage (0.75 UFL) was a nutritionally inferior feed to the kale (1.02 UFL) yet there was no difference in weight gain after turnout. In year 2, weight gains post turnout of heifers on the silage only treatment and those of heifers on nutritionally superior diets during the winter period were not significantly different and the silage only heifers failed to meet target weight at MSD.

CONCLUSION

The most important aspect of heifer rearing is the attainment of target weight at key time points during rearing. Over winter diet and spring turnout date have a large impact on heifer weight gain and therefore achievement of specified target weight.

NEW GRASSLAND TECHNOLOGIES

Evaluation of perennial ryegrass cultivars

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SUMMARY

- Grass cultivar evaluation protocols must be able to identify superior grass cultivars for current grass-based production systems.
- In the future there will be a requirement for on-farm grass cultivar evaluation to identify cultivars that perform best over a number of years under animal grazing, across a range of soil types and management systems.
- Only cultivars that are published on either the Irish or Northern Irish Recommended Lists should be used in Irish grass seed mixtures.
- The Grass Economic Index is currently being developed. The index will apply monetary values to each cultivar based on its seasonality of production, quality parameters and persistency for particular grass production systems.

INTRODUCTION

At Moorepark, research is ongoing towards the identification of perennial ryegrass varieties that will contribute to the maximisation of farm profit, particularly under intensive grazing regimes from the perspective of seasonal sward productivity, nutritive value, intake potential and animal performance. Research is focusing on identifying the optimum evaluation protocol for grazing systems, evaluation of cultivars at farm level and the development of the grass economic index. Other research areas include examining the performance of cultivars when sown as monocultures versus mixtures and identifying changes in sward composition that occur following sowing. This research will provide a list of suitable cultivars and seed mixtures for Irish grazing systems.

EVALUATION OF GRASS CULTIVARS

A recent experiment investigated the effect of cultivar evaluation protocol on seasonal and total DM yield. The objective was to identify the optimum protocol for evaluating grass cultivars which are suited to grazing systems. Four grass evaluation protocols were imposed as follows: i) Simulated grazing protocol (10 simulated grazing defoliations); ii) 1-Cut silage protocol (with six simulated grazing defoliations); iii) 2-Cut silage protocol (with 4 simulated grazing defoliations); iv) 3-Cut silage protocol (with 2 simulated grazing defoliations). Dry matter yield results showed a significant re-ranking of cultivars between management systems, with certain cultivars suited to grazing only systems, whereas other cultivars are more suited to intensive silage systems. These results highlight the need to match the grass cultivar evaluation protocol with represent the current and anticipated future needs of the industry. As a consequence of this research the Department of Agriculture, Food and Marine national cultivar evaluation trials in Ireland are now including a simulated grazing protocol to identify cultivars suited to intensive grazing systems.

ON-FARM CULTIVAR EVALUATION

Grass cultivar evaluation trials are generally managed under cutting in plot trials. It is important to know if the relative performance is expected to be similar when those cultivars are exposed to animal grazing at farm level. An on-farm research study began in 2010, across 18 commercial dairy farms to evaluate the performance of cultivars under animal grazing across a range of managements and soil types. The objective of this study is to gain a greater understanding of the DM yield performance and persistency of cultivars at farm level and to increase the information available on Recommended List cultivars. This study has been expanded in 2011 by including more participating farms.

EFFECT OF PERENNIAL RYEGRASS CULTIVAR ON ANIMAL PERFORMANCE

At Moorepark, an animal grazing experiment is investigating the effect of grass cultivar on milk performance. Four cultivars with different characteristics were selected: two tetraploids – Bealey (high spring growth) and Astonenergy (high quality) and two diploids - Spelga (control) and Abermagic (high WSC content). Cultivars were sown as monocultures and evaluated under similar rotation lengths and fertiliser application levels. Cows were offered 17 kg herbage daily (> 4cm). Initial results indicate that cultivar can influence animal performance with milk yield differences of up to 1.5 kg/cow/day between cultivars. These results are preliminary and the study is ongoing to obtain a greater understanding of the plant characteristics that contribute to improving animal performance from grazed grass.

RECOMMENDED LISTS

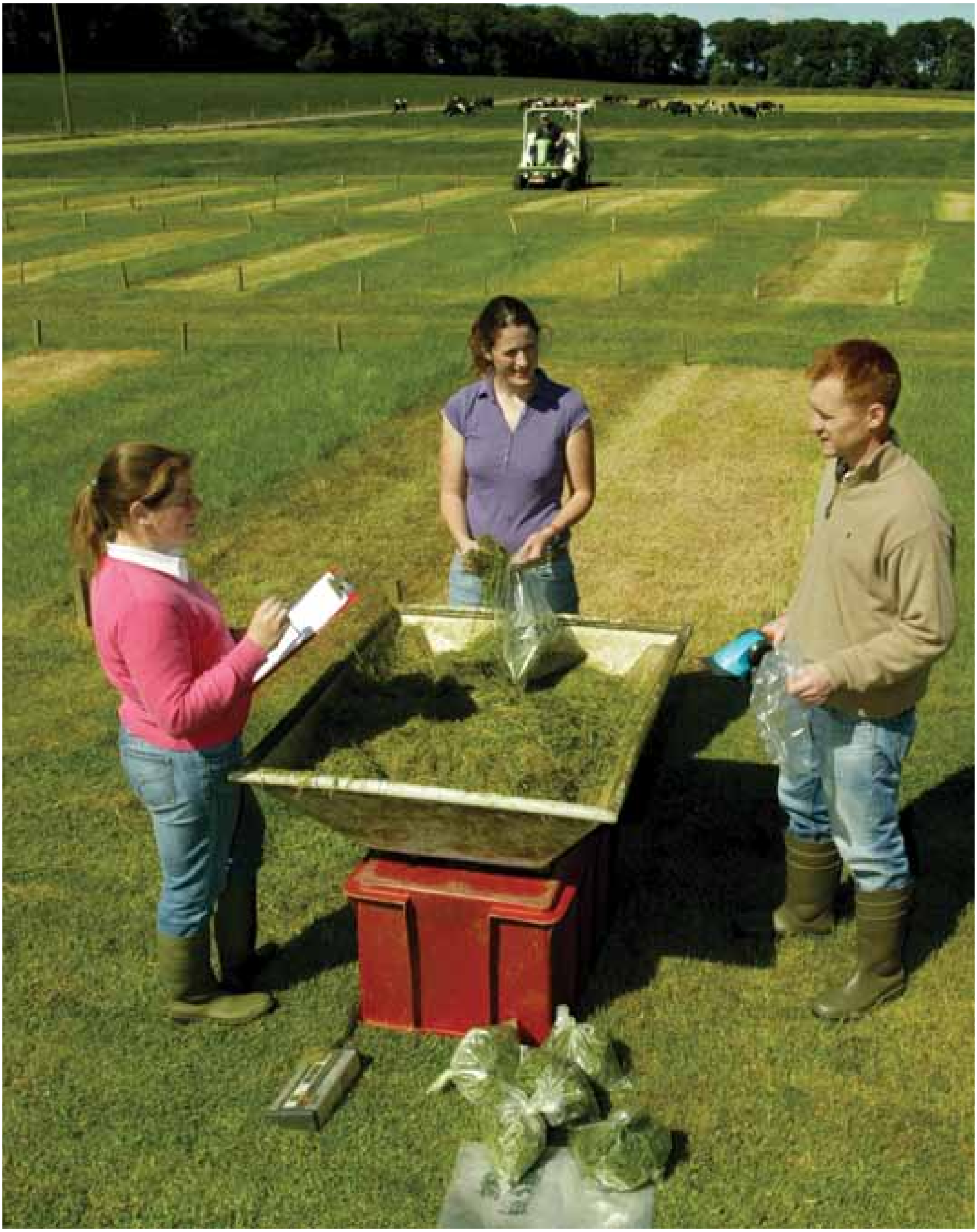
A 'Recommended Grass Varieties' list is published annually by the DAFM in the Republic and AFBI in Northern Ireland. The information presented for each cultivar includes spring, autumn and total DM yield, quality (DMD and WSC per cent) and ground cover scores. These two lists provide the best guide to ensuring Irish farmers are selecting appropriate cultivars for their grazing or silage systems. Only cultivars published on these lists should be used. The 2011 Irish Recommended List is at the back of this booklet for your convenience.

GRASS ECONOMIC INDEX

Ongoing research is working towards the development of an economic index for grass cultivars. The objective is to assign an economic value based on production and quality traits to individual cultivars. Economic values are derived for the important traits of grass production that can influence the profitability of a grazing system. These traits include: spring, mid-season and autumn DM yield, grass quality (April to September incl.), 1st and 2nd cut silage DM yield and persistency. By applying economic values to these parameters the economic merit of different cultivars can be ascertained, in a manner similar to how bulls are identified within the EBI. In the future we expect that farmers will be able to identify grass cultivars with the highest economic value for their system.

CONCLUSION

The suitability of some cultivars to grazing and others to silage based systems has highlighted the need to ensure the evaluation process is meeting the requirements of the grassland farmer. As a consequence, national variety evaluation trials in Ireland have moved towards testing cultivars under both a simulated grazing system and a 2-cut silage system. Animal performance studies being conducted at Moorepark together with the on-farm evaluation trials will further increase our knowledge with regard to the sward characteristics that influence animal performance and the traits most suited to grazing. The Grass Economic Index will provide grassland farmers with a methodology to compare the relative economic benefit of grass cultivars within various production systems.



Pasture reseeding

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SUMMARY

- Grass production on dairy farms can be increased by reseeding poor performing swards containing a low proportion of ryegrass.
- Ensure that recommended grass varieties are used when reseeding.
- With spring reseeding there is no loss in DM production in the establishment year compared to permanent pasture.
- The turnaround time of swards reseeded in the spring should be 60 days.
- It is essential that soil fertility (pH, P and K levels) is optimum when reseeding.

INTRODUCTION

There is now increased emphasis on increasing grass utilisation on dairy farms. There is huge variation in grass dry matter production on Irish dairy farms, as much as 50 per cent between farms and >100 per cent between paddocks within farms (Table 1). There are many contributory factors, e.g. soil fertility, soil drainage and management. Another principle factor is a low level of perennial ryegrass within pastures. Not only are non-perennial ryegrass species less productive, previous research has shown clear advantages in animal performance from perennial ryegrass swards compared to old permanent pasture.

Table 1. Mean grass DM production (t DM/ha) on a range of dairy farms across Munster in 2009 and 2010 and the range in paddock DM production within farms

Farm	2010	2009	max. 2010	min. 2010
Tipperary	11.7	11.2	14.1	8.7
Limerick	14.3	13.2	16.8	11
North Cork	13.8	12.3	20.3	7.2
Tipperary	13.7	14.4	17.8	8.8
Tipperary	12.8	12.4	15.8	9
North Cork	12.2	11	14.3	8.9
North Cork	12.3	9.9	14.8	7.5
North Cork	9.8	10.8	12.2	6.0
Tipperary	10	9.6	14.2	5.4

RESEEDED SWARDS ARE MORE PRODUCTIVE

A survey of 500 dairy farmers found that some reseeding took place annually on 50 per cent of participant's farms, 25 per cent reseeded infrequently, with 25 per cent never reseeding. The farmers who are not reseeding are losing out. Perennial ryegrass is a high quality feed and is nutrient responsive. Moorepark research has shown permanent pasture with low levels of perennial ryegrass to be on average 3t DM/ha lower yielding compared to perennial ryegrass dominant swards and 25 per cent less nutrient responsive. Figure 1 shows the dry matter production across the grazing season of a 15 per cent perennial ryegrass sward compared to a 100 per cent perennial ryegrass sward. The majority of the difference in DM yield between the two swards is accounted for up to mid May. Grass DM yields to support early spring grazing will not be achieved with swards containing a low proportion of perennial ryegrass. From an economic perspective, a low proportion of perennial ryegrass in the sward could cost an intensive dairy farmer up to €300/ha due to lower DM production potential of swards during the growing season. It is recommended that pastures with less than 65 per cent perennial ryegrass should be reseeded. When reseeding, ensure that grass varieties from either of the Irish (Republic or Northern) recommended lists are used. These varieties have been trialled and tested under Irish conditions. Cultivated soil should be tested, it is vitally important that soil fertility is optimal to ensure high performance from reseeded swards. Teagasc recommendations are to sow 14 kg seed/acre (35 kg/ha) to ensure good establishment of the sward. It is also advised to sow a minimum of 3 kg of each variety within a mixture.

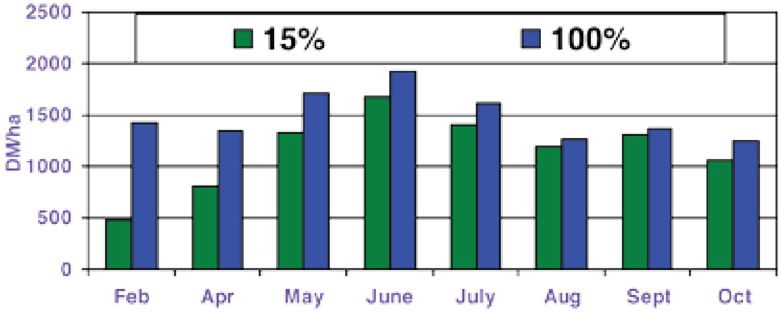

Figure 1. Herbage production from February to October on a sward with a low level of perennial ryegrass (15%) compared to 100 per cent perennial ryegrass sward.

TIMING OF RESEEDING

A lot of reseeding in Ireland is completed in the autumn. The main reason for this is that in autumn, grass supply is usually adequate in autumn, silage is harvested and the pressure for grass is off the system. In general, farmers reseed too late in autumn. The most effective months for reseeding are April and August. A study examining the impact of reseeding method in spring on DM production in the establishment year was completed last year at Moorepark. Grass DM production in the establishment year was One Pass (10.9t DM/ha) > Direct Drilling > Control (Permanent Pasture -10.5t DM/ha) > Discing > Ploughing. This study showed the DM production from a spring reseed produced as much grass as the Control treatment. Control of weeds is more effective in spring reseeds, most weeds will germinate and can be controlled with herbicide spraying. In autumn, post emergence herbicide control can be delayed due to prevailing weather or poor germination. In spring the target turnaround time for pasture to return to production should be 60 days.

CONCLUSION

Farmers need to identify the low producing paddocks on their farm and reseed them. The most suitable months for reseeding are April and August. There are small differences between reseeding methods.

Fertilizer recommendations for grassland

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SUMMARY – SOIL FERTILITY MANAGEMENT TARGETS

- Soil test the whole farm every 3 to 5 years.
- Aim for a pH above six for all grassland.
- All grassland should be Index 3 for P and K.
- Manage slurry and soiled water to maximise the fertilizer value.
- Deciding where slurry should be spread, and choosing the correct compound fertilizers is critical.

INTRODUCTION

Managing nutrients and soil fertility is crucial to ensuring that soil can meet the nutrient demands of a highly productive sward.

SOIL PH AND LIME APPLICATION

The optimum pH for grassland soils is 6.3. Lime should be applied to manage the soil pH, and the rate of lime application can be determined by soil analysis. Where lime requirements are greater than 7.5 t/ha (3 t/ac), apply 7.5 t/ha initially, and apply the remainder after two years. Lime can be spread all year round. Apply to bare swards if possible. Do not apply lime to swards close to silage harvesting. Incorporate lime into the seed bed when reseeding. Avoid applying urea fertilizer or slurry for three to six months after lime application, as lime can increase nitrogen (N) gas losses from urea and slurry.

NITROGEN (N) REQUIREMENTS

Match N fertilizer application to stocking rate at different times of the year to avoid excessive use. Apply N fertilizer 'little and often' during the growing season to get the most efficient grass growth response. The recommendations for farms on soils of average natural fertility are shown in Table 1. Less N fertilizer than recommended in Table 1 is required on soils with above average natural fertility or where there is plenty of clover in the sward. At stocking rates greater than 2.35 LU/ha slightly more fertilizer N (e.g. 8 kg N/ha) than is presented in Table 1 can be applied in southern counties and this should be applied in spring as part of the first or later applications.

P AND K REQUIREMENTS FOR GRAZED PASTURE AND SILAGE

P and K application rates should be based on the soil test results and on the purpose for which the field is used. Requirements for silage are usually higher than for grazing. The target soil index is Index 3. At Index 3, replace the P and K removed in product (milk and meat) or in silage. Apply additional P and K to Index 1 and 2 soils to increase soil fertility to Index 3; this may take a number of years to happen. Index 4 soils have sufficient P and K to meet requirements, and should receive no P or K fertilizer until soil test P or K declines to Index 3. Total P application on the farm and time of application must be compliant with nitrates regulations. There are no restrictions on K application rates and timings. The P and K advice for grazed swards is shown in Table 2.

Silage crops remove more P and K than does grazing. For first cut silage, add 20 kg P/ha and 120 kg K/ha to the grazing requirements. For a second cut, add an additional 10 kg P/ha and 35 kg K/ha. These additional rates should be applied to Index 1, 2 and 3 soils. They are not required for Index 4 soils.

Table 1. Recommended rates of N fertilizer (kg/ha) for grassland during the year where approximately half of the farm is cut for first-cut silage and the amount of second-cut is kept to a minimum (0 – 30% of the grassland area). Rates of fertilizer are presented in kg/ha (units/acre in brackets)

Stocking Rate		Jan-Feb	March	April	May	Jun	Jul-Aug	Aug-Sep	Total
LU/ha	*kg organic N/ha*								
1.8 - 2.0	155 - 170	0	28 (23)	45 (36)	25 (20)	25 (20)	25 (20)	25 (20)	173(140)
2.01-2.10	170 - 180	28 (23)	28 (23)	45 (36)	25 (20)	25 (20)	25 (20)	25 (20)	201(163)
2.11-2.20	180 - 190	28 (23)	37 (30)	45 (36)	34 (28)	25 (20)	25 (20)	25 (20)	219(177)
2.21-2.35	190 - 200	28 (23)	45 (36)	45 (36)	34 (28)	34 (28)	34 (28)	34 (28)	254(205)
2.36-2.47	200 - 210	28 (23)	45 (36)	50 (40)	45 (36)	34 (28)	34 (28)	34 (28)	270(218)
2.48-2.94	210 - 250	28 (23)	45 (36)	45 (36)	34 (28)	34 (28)	34 (28)	25 (20)	245(198)

Table 2. P and K requirements of grazed swards on dairy farms (rates shown are total requirements, before deductions for concentrate feeds (P only) and/or organic fertilizers (P and K). Rates of fertilizer are presented in kg/ha (units/acre in brackets)

	Farm Stocking Rate (LU / ha)					
	1.5-2 LU / ha		*2-2.5 LU / ha*		*>2.5 LU / ha*	
Soil Index	P	K	P	K	P	K
1	34 (27)	90 (72)	39 (31)	95 (76)	43 (34)	100 (80)
2	24 (19)	60 (48)	29 (23)	65 (52)	33 (26)	70 (56)
3	14 (11)	30 (24)	19 (15)	35 (28)	23 (18)	40 (32)
4	0	0	0	0	0	0

SLURRY IS A FERTILIZER

Slurry produced on the farm can be a valuable source of nutrients. Applying 11 m^3/ha (1000 gallons/ac) will supply approximately 4-12 kg N/ha, 7 kg P/ha and 47 kg K/ha. To maximise slurry P and K value, apply to fields with the highest P and K requirements. Timing and method of application are important to maximise the N fertilizer value. Best results are achieved by applying in cool moist weather conditions using injection, trailing shoe or bandspreader.

CONCLUSIONS

Soil testing the whole farm is critical so that the background soil fertility is known and nutrient requirements are identified. Proper management of soil pH and P and K fertility will ensure maximum returns from N fertilizer. Deciding where slurry should be spread, and choosing the correct compound fertilizers is critical.

Using white clover to increase profitability

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SUMMARY

- The cost of fertilizer N has been increasing at an average rate of nine per cent per year over the last decade.
- White clover can supply between 75 and 200 kg/ha of plant-available N in the soil each year.
- Well managed white clover-based systems are a profitable alternative to fertilizer N-based systems.

INTRODUCTION

The cost of fertilizer Nitrogen (N) has been increasing at an average rate of 9 per cent per year over the last decade. In contrast, milk price, although fluctuating widely in recent years, has remained relatively static. Consequently fertilizer N is becoming an increasingly expensive input. For example, in the early 1990's a dairy farmer had to sell 1.5 litres of milk to purchase 1kg of fertilizer N; in recent years it has been necessary to sell up to four litres of milk to purchase that same 1 kg of fertilizer N. This growing imbalance between input and output prices is not sustainable. The challenge is to find viable alternatives to fertilizer N.

Figure 1. The clover content of swards is around 5 to 15 per cent of pasture DM during April (left) and 35 to 45 per cent in August (right)

WHITE CLOVER

White clover is the most economically viable alternative to fertilizer N for Irish pasture-based systems. It has the capacity to convert (fix) atmospheric N into plant available N in the soil. Annual N fixation rates of between 75 and 200 kg/ha have been measured at Solohead Research Farm. Fertilizer N applied during the main growing season (April to September) can have a negative impact on N fixation. Clover can become lazy in the presence of fertiliser N, resulting in reduced stolon mass, loss of persistency and hence reduced N fixation. The exception is in early spring when clover is dormant. Fertilizer N can be applied for early grass and for first cut silage (up to mid-April) with relatively small impact on sward clover content and N fixation later in the season. Sward clover content is usually low in spring, increases during the main growing season and declines again over winter. The rate of N fixation increases as sward clover content increases.

High levels of milk production are being achieved from clover-based swards at Solohead. Milk output from the clover swards (1100 kg MS/ha) is 170 per cent of the national average, while fertilizer N input (90 kg/ha) is only 64 per cent of the average used on Irish dairy farms.

KEY COMPONENTS OF MANAGING WHITE CLOVER IN GRASSLAND

Over-sowing: Over-sowing (stitching in) is a cheap and effective means of maintaining the clover content of swards. It can be done using a fertilizer spreader, where the clover seed (5 kg/ha) is mixed with fertilizer, using a slug pellet applicator or similar broadcast seeder, or using a seed drill such as the Atchison, etc. The best time to over-sow is between early May and mid June before the ground gets too dry. Best results are achieved immediately after first-cut silage. Around 20 per cent of the farm should be over-sown each year to maintain white clover content. Reseeding can also be used to maintain the clover content of swards. Clover seed is very small and should be broadcast onto the soil surface. Seed buried too deep is a common cause of failure to establish during reseeding.

Tight grazing: Grazing to a low post-grazing residual (target 4 cm) has a big impact on the long term performance of clover in swards and on N fixation. Although it is important to graze tightly throughout the year, the most important time is during late autumn, winter and spring. Clover does not do well where heavy covers are left on swards for long periods during winter and spring. For clover swards, the ideal grazing rotation is around 21 days in spring and summer extending to 42 days in autumn.

Fertilizer: N management: Fertilizer N can be applied two to three times between mid January and late April for spring grazing. Likewise on silage ground fertilizer N can be applied for early grazing and for first-cut silage. However, fertilizer N applied subsequently can have a negative impact on sward clover content and on N fixation.

Stocking density: An average annual stocking density of approximately 2.2 cows/ha can be carried on a clover system, with a stocking density of up to 4.5 cows/ha during May and June, and over 3 cows/ha during July and August. This system is a profitable alternative to systems solely based on fertilizer N.

NEW RESEARCH AT MOOREPARK

A number of studies have commenced at Moorepark to examine the role of clover in higher stocking rate systems (>2.2 cows/ha). Dairy cow DM intake and milk production are currently being measured. A new approach to fertilizer N and grazing management is being investigated to examine the potential for better integration of fertilizer N and clover N fixation in swards. In the first year of that experiment, herbage DM production increased at all fertiliser levels when clover was included in the sward. This study will continue for a further three years to examine the persistency of white clover in the swards.

CONCLUSIONS

White clover can fix between 75 and 200 kg N/ha/year. With the cost of fertilizer N likely to continue to increase, it pays to learn how to make the most of white clover on your farm.

Grassland guidelines for winter milk herds

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SUMMARY

- Autumn-calving herds should aim to fully exploit grazed grass between February and November.
- Use a Spring Rotation Planner, incorporating strategic supplementation to meet demand.
- Heavy autumn grass covers are not suitable for freshly calved cows. Maintain pre-grazing yields at no higher than 1700kg/ha.

INTRODUCTION

Dairy herds with an autumn-calving component have a different milk supply pattern and feed demand profile compared to spring-calving herds. Contrary to perception, autumn calving systems should aim to maximize high quality pasture in the feed budget. Liquid milk herds on average produce over 70 per cent of annual milk output during the months of February through October. Thus, an opportunity exists to control feed costs by producing a large proportion of milk from grazed grass exists. For herds with autumn calving, the milk production calendar comprises four separate phases: i) **Indoor Feeding**; ii) **Spring Rotation;** iii) **Mid-Season** and iv) **Autumn Rotation**. A strong focus on good performance from pasture is required in three of the four phases.

SPRING ROTATION

Herds with autumn-calving cows have a high feed demand in early spring, especially at higher stocking rates. While there will not be enough grass to fully feed the herd until early April, it is important that grazing commences by mid-February. Apart from the benefits in terms of animal performance and the reduction of higher cost feeds in the diet, removing winter covers will stimulate fresh growth. In the Teagasc Johnstown Castle herd, a Spring Rotation Plan is implemented for all stocking rates (2.75, 3.25 and 4.0 cows/ha). The same proportion of farm area is grazed per week for each stocking rate, meaning less area per cow for the higher stocked systems. Differences in daily herbage allowance are balanced by adjusting indoor feed allowance. All systems have 1/3 of farm area grazed by March 1st, 2/3 grazed by March 17th, and the remainder grazed by April 10th.

The minimum allowance for an individual grazing bout is 4-5kg DM. At a high stocking rate, there is not enough grass on the area allocated to offer this much grass each day in early spring. During this period the high stocking rate group are offered grass by day for 4-5 days/week and housed by night (Figure 1). Indoor feed allowance is reduced on grazing days to encourage grazing to 4cm. The full indoor ration is offered on non-grazing days. Indoor feeding is reduced as grass availability increases. This flexible approach ensures that the herd is well-fed, weekly spring rotation targets are met, and grass is well set up for subsequent rotations.

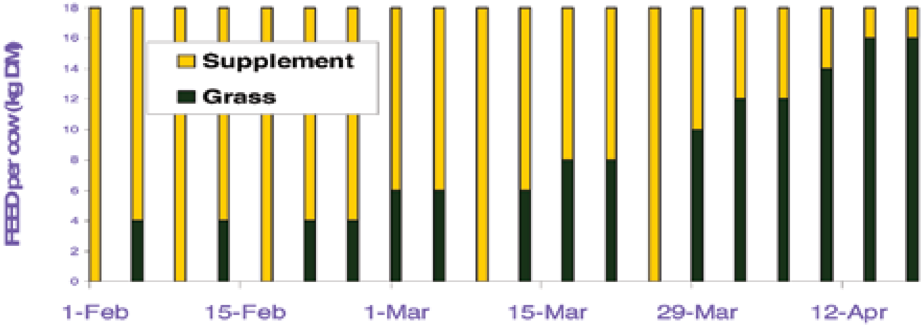

Figure 1. Feed budget for 4.0 cows/ha group in Johnstown Castle 2011

MID-SEASON GRAZING

Grazing management during the April-August period is similar for spring and autumn calving herds. The objective here should be to achieve as close to 100 per cent grazed grass in the diet as possible. Autumn-calving cows demonstrate a persistent milk production curve, with milk yields up to 90 per cent of peak possible at >200 days in milk. Ensuring a supply of highly digestible pasture (1200-1400kg DM pre grazing yield) is essential to realise this potential. The summer grass wedge can be used to identify emerging pasture surpluses or deficits. With a target cover per cow of 170kg DM, surpluses are removed as bales if grass cover exceeds 190kg DM, while supplements are introduced when cover drops below 140kg DM. Target post grazing residual is 4cm. In-parlour concentrate feeding can balance deficits up to 5kg DM/day, above which extra forage is needed.

AUTUMN ROTATION

High pre-grazing yields (>1700kg DM) arise when extending autumn grass supply for spring herds, but this is not suitable for freshly calved cows. Autumn grass has high crude protein but 20 per cent lower energy compared to spring grass. Freshly calved cows should not be consistently offered autumn grass with yields over 1700kg DM/ha. Calving pattern dictates how best to avoid this. Where over 50 per cent of the herd is autumn calving, farm grass cover should not exceed 800kg DM/ha in mid-September. When demand falls due to drying off, surpluses should be removed in mid-August, as silage or by grazing with non-milking stock. A lower farm cover during September generally means grazing is complete by early/mid November, but should be balanced by earlier turnout. For herds with less than 50 per cent autumn calving, autumn grass should be managed to suit the bulk of the herd. This means building cover to sustain a long grazing season for the spring calved cows. The problem of high pre-grazing yields is circumvented by shifting to later autumn calving, minimizing autumn grass in the fresh cow diet.

CONCLUSIONS

Quality grazed grass can reduce feed costs for almost 75 per cent of milk produced in a winter milk scenario. A grazing rotation plan is essential for the spring period. Diet quality in mid-season is maintained by holding pre-grazing covers at 1200-1400kgDM. Freshly calved cows in autumn should be offered pastures with covers no greater than 1700kg DM/ha. Throughout the grazing season, decisions on supplement feeding should be made in tandem with grazing targets.

Teagasc heavy soils dairy programme

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SUMMARY

- Approximately 30 per cent of the milk produced in Ireland originates from farms classified as having heavy soil type.
- A new research programme has been established to explore the most cost effective and efficient means of profitably increasing milk production on heavy soils.
- Monitor farms have been identified in counties Clare, Kerry Limerick and Cork.
- Research findings from drainage trials at Solohead will be integral part of the programme.

INTRODUCTION

A large proportion (circa 30 per cent) of milk produced in Ireland originates from farms where the soils can be classified as heavy. Heavy soils add complexities to the production system that are aggravated by inclement weather conditions. A new research programme has been established focusing on the skills and technologies that will facilitate expansion and maximise profitability on farms with heavy soils. This will necessitate the adoption of key technologies including land improvement strategies, quality pasture management, compact calving, increased stocking rates, risk management, genetic improvement, heifer rearing strategies and low cost labour efficient farm infrastructures.

OBJECTIVES

- » The establishment of a research programme to find the most cost effective and efficient means of increasing profitability on heavy soils.
- » To test and implement findings from Teagasc, Solohead drainage research on monitor farms.
- » To evaluate commercially focused, expanding family farms demonstrating financially rewarding business growth on heavy soils.
- » To hold regular farm focus days to provide information to help decision making.
- » To provide guidance in the design, construction and operation of new low cost grass-based dairy farm infrastructure, incorporating the most efficient and cost effective technologies for land and pasture improvement.
- » Inform the dairy industry about activities and innovations coming from the project.

PARTICIPANTS

The programme is a collaborative project between Kerry Agribusiness, Dairygold and Research and Advisory personnel from Teagasc. To-date five farmers have agreed to participate as monitor farmers in the programme while a sixth farm is to be identified. The farms were selected taking cognisance of 1) the requirement for a range of challenging soil types; 2) regional distribution; 3) potential for sustainable profitability and 4) willingness of the farmer to participate fully in the project. The farms selected are described below:

DOONBEG, CLARE

The farm has a peat soil, with poor drainage and is in an area of high rainfall. The current farm operation is totally devoted to dairying and has expanded from 20 cows to 70 cows over the past 10 years with a target of milking 100 cows on the existing land base of 47ha.

LISTOWEL, KERRY

This farm also has a peat soil and is run as a father and son partnership. The farm business has been expanding, currently milking 75 cows with plans to increase to 100 on 52 ha.

CASTLEISLAND, KERRY

Seventy one ha holding (20 ha on a long term lease) has a heavy clay soil with good depth but poor permeability. There are 82 cows milking, and it is planned to expand to 120 cows.

MID-CORK

This farm is located near Macroom, Co. Cork. It has a heavy clay soil with poor permeability and quite stony in places. There are 80 cows milking on 69 ha (13 ha on a long term lease) with plans to expand to at least 100 cows.

NORTH CORK

This farm has a mix of free draining that is soil that is well developed and maintained (50%) and recently acquired heavy clay soil with poor permeability. There is a requirement for substantial development work to be completed on the farm. This farm is characterised by steep hills. There are 75 cows milking with plans to expand to 100 cows on 50 Ha.

Business plans will be drawn up for each farm working closely with the farmers involved. These plans will form the basis of the expansion and will drive the land improvements necessary to achieve these objectives. A web page has been constructed to disseminate information from the programme to interested farmers and advisory personnel and is available on the Teagasc website http://www.teagasc.ie/heavysoils

CONCLUSION

With the abolition of milk quota in 2015, there are great opportunities for expansion in milk output. This five year project, which started this year, will apply the most appropriate technologies across a range of challenging soil types to ensure efficient and profitable expansion.

NEW ENTRANTS TO DAIRYING

Scheme for the Allocation of Milk Quota to New Entrants to Dairying

PAUL SAVAGE

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OVERVIEW

As part of the Health Check agreement in November 2008, the Council of Agriculture Ministers agreed to increase Member States' milk quotas annually by 1 per cent over the period 2009 to 2013. The third of these increases came into effect on 1st April 2011.

In each of the three years to date, the Minister for Agriculture, Fisheries & Food has announced that one quarter (0.25%) of the increase is to be allocated on a permanent basis to new entrants to dairying.

The New Entrants Scheme is the vehicle through which these quota allocations have been made. In 2009, 72 allocations to new entrants were made, and in 2010, there were 74 allocations to both 'brand new' entrants and to those who had previously purchased quota as new entrants through the Milk Quota Trading Scheme. A third category of recipient, who had purchased quota as successors through the Milk Quota Trading Scheme, was added in 2011. The results of the 2011 Scheme were announced recently, with a total of 84 successful applicants identified. This brings the total number of new entrants receiving milk quota under the Scheme to date to 230, and the total quota allocation to more than 42 million litres.

The Road Map for the Implementation of Food Harvest 2020 in the Dairy Sector specifies that a New Entrants Scheme should accompany each of the remaining Health Check milk quota increases. The Minister has announced that this is to be acted upon, by confirming recently that a New Entrants Scheme will take place in each of 2012 and 2013. Details will be announced by the Department early in each year.

NEW ENTRANT CATEGORIES

The Scheme provides for three New Entrant categories, namely:

- **CATEGORY A:** Brand New Entrant to Dairying. An applicant under this category must have no milk quota, nor have been a producer previously, either in his/her own name or jointly.
- **CATEGORY B:** Purchaser of Quota as a New Entrant through the Milk Quota Trading Scheme. An applicant under this category may be a milk quota holder, provided quota was purchased by him/her under the category of New Entrant in any of the Milk Quota Trading Schemes to date.
- **CATEGORY C:** Purchaser of Quota as a Successor through the Milk Quota Trading Scheme. An applicant under this category may be a milk quota holder, provided quota was purchased by him/her as a Successor in any of the Milk Quota Trading Schemes to date.

ELIGIBILITY CRITERIA

In order to be eligible for consideration, each applicant must:

» satisfy the education and training qualifications as outlined in Annex I of the detailed rules of the Scheme.

» have/will have a holding comprised of lands owned and/or leased by him or her.

» have/will have his/her own separate independent herd number in which the dairy animals are/will be registered.

» have his/her own separate milking and milk storage facilities situated on his/her holding prior to commencement of milk production.

» submit a 5 year business plan.

ASSESSMENT OF APPLICATIONS

A rigorous assessment of all applications that satisfy the eligibility criteria is carried out by an independent assessment group, which selects what it considers to be those applications that provide the best evidence of a viable and sustainable dairy enterprise. The assessment focuses on the following areas:

» Educational Qualifications.

» Experience and background in farming, especially dairy farming.

» Business Plan, showing commitment to dairy enterprise and its future development.

» Financial Input, and particularly any personal financial commitment.

» Independence of the proposed dairy enterprise.

ALLOCATION OF QUOTA

Category A (Brand New Entrant to Dairying) - a maximum of 50 successful applicants to this category is typically allocated a milk quota of 200,000 litres,

Categories B and *C* - the quota remaining after allocations to Category A recipients is divided among suitably qualified applicants under these categories. However, allocations are capped so that the applicant's total permanent quota, including any quota allocated under this scheme, does not exceed 200,000 litres.

COMMENCING PRODUCTION

Successful applicants under Category A and Category C above are required to commence milk production by 1 April in the second year after the results of the scheme have been announced, i.e. successful applicants in 2011 have until 1 April 2013 to commence. Category B applicants must comply with the existing Milk Quota Trading Scheme commitment to commence production within 15 months of receiving their Trading Scheme allocation.

Before commencing production, any new entrant's holding must be registered as a dairy holding under the European Communities (Food and Feed Hygiene) Regulations 2009, S.I. No. 432 of 2009 and the holding must comply with the requirements of these regulations before milk is delivered to a milk purchaser.

All new entrants to dairying must notify the milk purchaser and the Department of their intention to commence milk deliveries at least 30 days prior to the date of commencement.

GENERAL CONDITIONS

Quota allocated under the Scheme is for the use of the successful applicant only, for as long as he/she remains in milk production, and is subject to the normal conditions in relation to transfer, disposal or temporary leasing that attach to allocations of National Reserve quota.

If quota acquired under the Scheme is produced on leased lands, such quota shall not, on expiry or earlier determination of the lease agreement, transfer with the lands.

Successful applicants are eligible to purchase quota in the Milk Quota Trading Scheme.

Applicants under Category A who receive quota under this Scheme may not:

- merge with another enterprise in any form for a period of 3 years,
- benefit from the transfer of quota for a period of 3 years, except through inheritance following the death of the transferor,
- transfer the quota except to a successor in the event of the death of the producer, provided the successor remains in milk production.

Successful applicants are required to submit a financial statement to the Department at the end of each year. They are also required to attend training, facilitated by Teagasc, which they are informed about in the weeks following notification of their successful application.

Full details of the New Entrants Scheme are available from the Milk Quota Section, Department of Agriculture, Fisheries and Food, Agriculture House, Kildare Street, Dublin 2. Details are also available on the Department's website at www.agriculture.gov.ie.

A profile of new entrant dairy farmers

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SUMMARY

- The New Entrant Dairy Scheme commenced in 2009 and has allowed 70 new dairy farms per year to commence production.
- The majority of New Entrants are located in the south east of Ireland, with over 50 per cent converting from a beef enterprise.
- The average new entrant infrastructure budget is €160,000 and will be mainly financed by borrowings.
- The average new entrant has a farm of 57 hectares, plans to milk 72 cows and produce over 360,000 litres of milk/annum and have significant potential for expansion in the future.

INTRODUCTION

The anticipated 50 per cent increase in national milk production post EU milk quota abolition is based on the presumption of increased scale of existing dairy farmers as well as an influx of new entrants to the Irish dairy industry. As part of the Irish milk quota expansion policy, the Irish government has decided to allocate one quarter of the annual one per cent increase in milk quota to new entrants. Each new qualifying farmer will receive 200,000 litres of milk quota to create a new stand alone dairy farm business. National farm survey statistics reveal that dairying is the most profitable enterprise, and consequently the New Entrant Dairy Scheme, which started in 2009, has become an attractive option for farmers in other lower margin enterprises. Many factors are likely to influence the success of these new businesses. These include the level of investment in infrastructure, the efficiency of production, the rate of expansion in production as well as external influences such as interest and inflation rates. As part of the application process, each successful new entrant applicant provided a detailed five year business plan incorporating physical and financial plans in addition to information on the location of their planned enterprises. This group of new dairy producers represent the initial evolution of the dairy industry in Ireland post EU milk quotas, and provide a unique opportunity to examine the characteristics of new dairy producers entering the industry. Approximately 140 new entrants have commenced production in the initial two years of the scheme. The number of applications to the scheme has increased significantly each year, exceeding 200 applications for the first time in 2011. It is vitally important that these new entrants develop successful businesses within the dairy industry in future years.

A PROFILE OF NEW ENTRANT DAIRY FARMERS

Since 2009, over 140 new dairy entrant applicants have been accepted into the scheme. From our analysis, a profile of the average new entrant is outlined in Table 1 and 2 below. The majority of new entrants (72%) are located in the south east of Ireland (Waterford, Tipperary, Cork and Kilkenny) with the balance distributed between the Border Midlands and West (18%) and the South West (10%). Over half were previously in beef production, with the majority of the remainder coming from a mixed farming enterprise (combining sheep, beef and tillage). With an average farm size of 72 cows on 57 ha, the new entrant farms will be lowly stocked during the initial years of the new business. There is, however, significant potential for milk production expansion on these dairy farms in the future.

Table 1. General characteristics of the average New Entrant dairy farmer over the next five years; from the successful 2009 and 2010 applicants

General Characteristics	Age
Age (yrs)	36
Farm systems characteristics	
Land area farmed (hectares)	57
Herd size (No. cows)	72
Replacements (No. heifers)	25
Stocking rate (LU /ha)	1.8
Milk yield (litres/cow)	5,000
Milk solids (kg/cow)	385
Total annual milk supply (litres/farm)	360,000

The average budgeted infrastructure investment is €160,000 with the majority earmarked for the development of milking parlours and animal accommodation and for the purchase of dairy stock. This capital investment plan initially appears to be a very conservative estimate of the set up costs however, 35 per cent of the applicants are developing their new enterprises on farms that were previously in dairying and so may already have some of the necessary infrastructure in place. The planned infrastructural investment will largely be funded by borrowings (~€100,000) in addition to savings and the sale of existing stock from the previous enterprise. In terms of the predicted financial performance, the average milk price expected by new entrants is 26 cent/litre while the estimated financial returns are outlined in Table 2. On average, new entrants plan on production costs of 24 cent/litre including four cent/litre for interest and depreciation. Hence, the average new entrant is consequently budgeting on profitability of six cent/litre (equivalent to €285/cow or approximately €21,500/farm). While this appears to be a relatively poor return on investment, these new dairy farms will be considerably more profitable than non-dairy enterprises of comparable size and have significant potential to increase profitability in the future using the infrastructure that will have been put in place during the initial setup.

Table 2. Financial Performance of the average New Entrant dairy farmer over the next five years from the successful 2009 and 2010 applicants

Financial Projections	cent/litre
Gross Output	29
Total Variable Costs	12
Total Fixed Costs (incl. depreciation & interest)	11
Net Profit	6

CONCLUSIONS

There is now major interest in the New Entrant Dairy Scheme arising from the greater profitability of dairying in comparison to other enterprises. There is a significant regional trend in the applications with the majority of New Entrant dairy businesses arising in the south east. While these farms are likely to operate as lowly stocked farm systems in the initial years, they have considerable potential for expansion into the future.

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Infrastructure requirements for a Greenfield dairy farm

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SUMMARY

- Plan new milking facilities carefully paying particular attention to location and specifications set out by the Department of Agriculture, Fisheries and Food and the Teagasc/IMQCS Recommendations for the Installation and Testing of Milking Machines.
- Plan to allow for milking an expanded herd in no more than 1 hour 30 minutes.
- Bulk tanks should be sized to allow for an expanded herd.
- Farm roadways should allow cows to walk comfortably at three km/hr with their heads down so that they can see where they are placing their front feet.
- Water systems should be sized to deliver sufficient water to meet the stock needs during periods of greatest demand.

Installation standards for milking machines: The first port of call for planning a new dairy should be to consult the specification S106, 'Minimum Specification for Milking Premises and Dairies' published by the Department of Agriculture, Fisheries and Food. In particular it is important not to overlook the presence/proximity of an open slurry tank. The parlour must be at least 10 meters (preferably more) from an existing open slurry tank. It must not share a common wall with silage or ensiled material. Location in relation to surface waters and a public water supply source are also important considerations. International and Irish Milk Quality Co-operative Society (IMQCS) standards exist and are a basis for installing a new milking machine. This publication is essential reading and can be downloaded from www.milkquality.ie.

Milking equipment: The choice of milking system should be directly related to the number of cows currently being milked and the herd size envisaged for the future. Plan to allow for milking an expanded herd in no more than 1 hour 30 minutes. Generally it is better to focus on having an adequate number of milking units at the expense of high levels of automation. The installation of bailing systems allows cows to be located conveniently for proper operation of ACRs. There is considerable debate on the feasibility and necessity of installing bailing systems in new milking parlours. The main advantage with bailing systems is that cows are controlled and positioned better for easy cluster removal, compared to straight-breast rail or angled mangers.

Collecting yard: There are two aspects to consider when sizing a collecting yard, 1) the average size of cows in the herd and 2) the herd size. Small cows require 1.2m^2 per cow and large cows require 1.5m^2 per cow. Multiply average cow size by the maximum number of cows that need the yard at one time to calculate the total area required. Both circular and rectangular yards have positives and negatives.

Rectangular Yards	Circular Yards
Easier to build	More complex to build
Can be extended easily	Difficult to enlarge
Promotes good cow flow if cows enter from rear	Promotes good cow flow
Important to taper the yard towards dairy entrance	Possible to put second herd onto same yard without moving backing gate

Grazing infrastructure: Division of grazing land into paddocks is essential to be able to successfully manage pastures and achieve desirable rotation intervals. An accurate map of the farm is essential. The ideal paddock system should include 20 to 23 paddocks. These should be big enough so that there is sufficient pasture for the full herd for 24 hours when the pre-grazing cover does not exceed 1300-1500 kg DM/ha on a 21 day grazing rotation.

A few small paddocks near the parlour should be provided to accommodate sick cows. Paddocks should be rectangular to square in shape and wetter paddocks should have their longest sides running adjacent to the races to avoid poaching in wet weather. Use multiple gateways from the roadway for paddocks on wet ground.

Farm roadways, construction aims: Farm roadways should have a raised, wide, smooth, dry, gently crowned surface with gradual sweeping bends. Plan the route on a map but finally decide once it is marked out on the ground. Roadways for herds of up to 200 cows should be 4m wide and over 200 cows, 5.5m wide. About 150mm of topsoil can be removed to get a more solid base and stop material spreading. Digging too deep will cause cost over run. Laying the base material on top of the ground also works well and reduces the cost of construction. Lay base material and shape to form a crossfall (1 in 20 to 1 in 30) to one or both sides. Compact with a large vibrating roller e.g. 19 tonne and leave it time to settle. Use dusts of sandstone, shale, greywacke, etc., but not limestone dust for blinding the roadway (about 50mm thick). Corners must have a wide sweeping curve. A low concrete kerb (150mm) at the junction of the race and the yard will mean less stones are kicked onto or carried from the roadway onto the yard. This will reduce the risk of lameness due to stone injuries. The lead in and exit from the milking parlour should be straight for at least 30 meters. The cost per metre can vary greatly, from €15 to €30/metre, depending on the cost of materials, width and the method of construction.

Water system layout: Divide the farm into sections, with a shut-off valve at each major junction. Mark pipe location, pipe sizes, joiners and shut-off valves on a large farm map. Consider installing a water flow meter near the supply pump. This will monitor water usage and can be used to detect leaks. A ring main is a cost effective way to enhance water flow rates and pressure to troughs. Use gravity if possible to reduce pumping costs and improve pressure. Main pipe sizes would typically be 25mm, 32mm or 40mm and branch pipe sizes would be either 20mm, 25mm or 32mm (internal diameter). Larger pipe diameters provide less resistance and higher flow rates. Water available to cows is a combination of trough volume and water flow rate, e.g. a trough volume of 1400 litres (about 300 gals) will provide 14 litres per cow for 100 cows and a flow rate of 0.2 litres/cow/minute will provide 12 litres /cow/hour. Use full flow ballcocks in all new troughs. Troughs on roadways will slow cow movement and make roadways dirty.

CONCLUSION

The conversion of a green field site to a working dairy farm is a significant task. Failure to plan ahead and manage this project will result in an unsatisfactory outcome including additional costs, missed deadlines and increased stress for the farmer. Minimising capital requirements in areas that do not affect productivity of the business has to be the main focus of successful expansion in the future.

Financial planning for expansion

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SUMMARY

- Expansion must be based on a business plan which sets out realistic objectives and develops strategies to manage risk.
- The business plan should be based on realistic targets in relation to grass productivity and dairy cow performance.
- A positive cash flow is the most important component in the initial period of the investment and is a fundamental requirement to ensure liquidity.

INTRODUCTION

Irish dairy farmers will have to decide in the short term whether they plan to expand their dairy business, remain static or exit milk production altogether. Likewise non dairy farmers will need to consider the possibility of becoming dairy farmers. Capital investment required, production costs and milk price will be the main determinants of the rate of expansion. The development and application of a business plan is the first step in the development of a thriving and successful business.The objective of this paper is to present background to the development and application of a dairy farm business plan using the Kilkenny Greenfield Dairy farm as a case study.

OBJECTIVES

The first component of developing a business plan is to complete an audit of resources on the farm. The next component is to develop the objective for the farm. The objective of the Greenfield Dairy business is to maximize the return to the shareholders, farming in an environmentally and animal friendly manner, while at the same time maximizing labour efficiency. A "Mission Statement" is a short statement on what you want the business to deliver including both financial and personal objectives. Every individual is different and therefore requirements will be different and may change depending on the stage of life and/or with the presence of family. For example one possible Mission Statement may read; "In five years time, I want to be milking 100 cows, working 40 hours/week and earning €100,000 from the farming enterprise." It will be difficult for the business to deliver a successful outcome if the objective from the business is unclear.

PROJECTIONS

The most important component of any start up and expanding business is liquidity, especially in the current Irish economic climate. A realistic cash flow projection for the farm will provide the background to determine if the proposed business is viable. A cash flow statement essentially shows the cash movement onto the farm in the form of sales and other expected income from the farm as well as all expected cash costs from the farm. This cash flow projection should be developed in a monthly time step. When putting the plan together it is extremely important that realistic assumptions are used in relation to expected biological performance as well as input and output prices. Be conscious of the fact that performance may be compromised initially where herds are assembled. Inflation projections should be included in the input variables to ensure realistic price projections are used. Sensitivity analysis should be carried out to evaluate the robustness of the business to changes in key input variables such as milk price, interest, labour and whatever other costs are pertinent to an individual's circumstances.

Table 1 shows the biological, interest, capital repayment and surplus cash projections for the Kilkenny Greenfield dairy farm for Years 1 to 15 (further details http://www.greenfielddairy.ie). Table 1 shows that the projected cash flow on the farm is low in the first four years at a base milk price of 24 cent/litre. This farm has a significant fixed cost element as a result of the land rental charge of €52,000, labour costs of €88,000 and interest repayments of €25,000 with capital repayments being incurred from year 3 onwards. Increasing the level of grass utilized through increased stocking rates and the subsequent effect on increased milk output coupled with increases in milk yield per cow, milk solids concentrations and reductions in veterinary costs, culling and mortality all combine to increase the surplus cash generated. Over the lifetime of the investment it was projected that the farm would generate €853,218 in surplus cash with all borrowings paid back and stock with a value of €523,500.

Table 1. Farm projections over the 15 years of the investment

Year	Cow	Milk Produced Kg	Interest Repayment €	Capital Repayment €	Surplus Cash €	Borrowing Year-end €
1	250	€1,245,976	24,175	0	24,093	749,650
2	270	€1,383,619	38,734	0	4,403	749,650
3	290	€1,517,064	38,734	0	30,101	749,650
4	300	€1,602,113	38,734	48,477	17,715	701,173
5	310	€1,669,677	36,553	50,658	30,156	650,515
6	320	€1,738,864	34,273	52,938	48,376	597,576
7	330	€1,795,874	31,891	55,320	60,471	542,256
8	340	€1,849,056	29,402	57,810	69,977	484,446
9	350	€1,903,440	26,800	60,411	79,465	424, 035
10	350	€1,903,440	24,082	63,130	90,321	360,906
11	350	€1,903,440	21,241	65,971	89,024	294,935
12	350	€1,903,440	18,272	68,939	87,561	225,996
13	350	€1,903,440	15,170	72,041	81,715	153,954
14	350	€1,903,440	11,928	75,283	75,869	78,671
15	350	€1,903,440	8,540	78,671	63,971	0
Total Cash Surplus					853,218	
Stock value at end of period						
Cows 300* €1,300					390,000	
Replacement heifers					84,500	
65* €1,300						
Yearlings 70* €700					49,000	
Cash Surplus + Stock Value					**1,376,718**	

CONCLUSIONS

There is huge variation in the level of efficiency on dairy farms. The farms that are the most efficient will have the greatest opportunity to expand and suffer less risk from price volatility. While there will be opportunities for expansion post-quota, these opportunities should only be grasped if they will result in increased profitability.

Update on the Greenfield dairy farm

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SUMMARY

- In 2010 the Greenfield Farm performed ahead of budget mainly due to the higher milk price.
- Herbage production averaged 13 t DM/ha; well ahead of the projected 9.2 t DM/ha.
- Milk production was below target due mainly to delays in getting the herd established.
- The significant investment in animal health disease screening and vaccinations resulted in no serious health issues on the farm to date.

INTRODUCTION

The Greenfield dairy farm was set up in late 2009 and 2010 was its first milk production year. The business model is to produce milk at the lowest cost possible while minimising capital investment. Adoption of low cost technologies and maximising the amount of grazed grass in the diet is central to the plan. The economics of milk production at farm level will be a major determinant of the extent to which national milk supply will increase when milk quotas are removed. Achieving the target performance in relation to both grass production and utilisation as well as animal performance will determine sustainability in the longer term. Within the Kilkenny Greenfield project assumptions with regards to pasture, animal and labour productivity have been made. Success or failure will be decided on their delivery.

PERFORMANCE IN 2010

Table 1 summarises the trading profit and loss account and operating cash flow statement compared to the projections. These figures have been summarized for the purpose of this analysis and are presented in more detail at http://www.greenfielddairy.ie under the management policies section of the Greenfield Farm website.

Physical performance 2010 In 2010, development of the farm continued while operating as a functioning farm. The stock numbers and production targets were not reached until May, resulting in below projected performance up to June. The farm largely performed to target after this point. Milk sales from the farm were 150,000 litres below target for 2010. Milk protein and fat content were 0.14 per cent and 0.38 per cent above target, respectively. Milk solids sales from the farm were 4,821kg lower than projected. Excellent SCC levels were obtained considering the herd consisted of groups of animals brought together from many differing sources and of varying lactation numbers. Both cow and calf mortality rates were considerably lower at 2.6 per cent and 5.5 per cent, compared to that budgeted at six per cent and seven per cent, respectively.

Profitability 2010 An important component of any start–up operation is to generate sufficient cash surplus. While the farm may not be profitable, solvency is ensured when surplus cash is generated. In the 2010 performance figures when inventory change was taken into account the change in livestock numbers due to culling had a significant negative effect on profitability. This, however will become much less of an issue in 2011 as there will be two lots of young animals (heifer calves and in-calf heifers) to counteract the effect of animal culling and mortality. In the original budgets, the inventory change effect in the livestock numbers was only taken into account at the end of the investment thus ensuring that the value of livestock change was not double counted. When actual profitability is compared with projected profitability (Table 1), with the livestock number change accounted for in Year 15, the farm broke even, against a projected loss of €7,000.

Surplus cash 2010 The operating cash flow for the farm (separate from the farm development) is shown in Table 1. It shows the operating cash projections for 2010 compared to the actual cash using the same methodology. As evidenced by the data in Table 1, the farm operating cash surplus projection was €24,093, while the actual operating cash surplus was €47,239.

Table 1. Actual versus projected profit and operating cash flow budget for 2010

Farm	Profit		Cash	
Receipts	**Projected**	**Actual**	**Projected**	**Actual**
Milk	310,174	338,858	310,174	338,858
Livestock	47,223	59,091	47,223	59,091
Sales	357,397	397,949	357,397	397,949
Variable Costs				
Concentrate	9,694	11,874	9,694	11,874
Fertiliser, lime & reseeding	27,480	24,758	27,480	24,758
Livestock rearing	30,209	28,778	30,209	28,778
Contractor	11,828	10,232	11,828	10,232
Silage making	15,531	20,339	15,531	20,339
Vet/ AI & medicine	34,453	35,186	34,453	35,186
Other	4,000	5,275	4,000	5,275
Total variable costs	**133,195**	**136,442**	**133,195**	**136,442**
Fixed Costs				
Wages and salaries	88,800	87,810	88,800	87,810
Land lease payable	52,200	53,409	52,200	53,409
Insurance	6,571	4,789	6,571	4,789
Machinery running and repair	11,554	24,036	11,554	24,036
ESB & oil	5,775	5,845	5,775	5,845
Telephone	2,400	9,43	2,400	943
Hire of equipment		1,535		1,535
Diesel & motor expenses jeep	4,296	3,758	3,634	3,758
Consultancy	1,500	681	1,500	681
Accountancy	3,500	13,563	3,500	13,564
General expenses	30,496	777		777
Depreciation		47,121		
Bank loan interest	24,175	17,121	24,175	17,121
Total Fixed Costs	**231,267**	**261,389**	**200,109**	**214,268**
Surplus	**-7,065**	**118**	**24,093**	**47,239**

Cash flow The 2011 cash flow budget has been set for the farm based on a plan to milk on average 295 cows (Table 2) (see http://www.greenfielddairy.ie). Cow numbers were not expected to reach this level until Year 4. However, as a result of better than expected herbage production, it was decided to accelerate the rate of expansion of the herd, which consequently increased milk output from the farm. It is expected that the majority of the increased milk output will be achieved through higher grass utilization and not from additional concentrate input. It is projected that milk output from the farm will be 1,350,000 litres in 2011 with similar milk solid concentrations to 2010 (3.54 per cent protein and 4.22 per cent fat). A base milk price of €4.34/ kg milk solids (30.8 c/l) is included for 2011. It is expected that the farm will generate just over €72,687 in surplus cash in 2011 based on the performance projections and expected input costs and output prices, which is substantially ahead of the original budget.

The Greenfield board of management decided to ring fence a large amount of this surplus cash as a reserve fund for the farm. From 2012 both interest and capital will be repaid on a yearly basis over a 13 year period based on the original plan.

Performance 2011 Performance to the end of May 2011 is ahead of target. Milk deliveries are ahead of budget by approximately 30,000 litres, and calf sales by €5,000, fewer cows have been culled and died compared to the budget. However, there has been an unexpected outbreak of TB which has resulted in the removal of 13 cows to date. Peak milk yield was achieved at the end of April at just over 24 kg of milk per cow or 1.82 kg of milk solids per cow. This peak was maintenance until the second week of June. Milk solids output from the farm peaked 1.3 kg of milk solids / hectare / day higher in 2011 compared to 2010 (Figure 1). Total milk output from the farm up until the end of May was 485,482L and 39,641kg milk solids while the corresponding figures for 2010 were 293,873L and 21,785kg MS (Table 3).

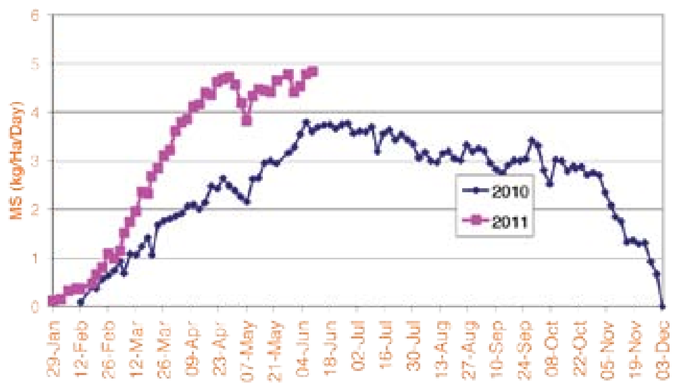

Figure 1. Daily milk solids production per hectare in 2010 and in 2011

Table 2. Greenfield Dairy Farm Budget 2011

	Total	1st Qtr. *128,493*	2nd Qtr. *537,056*	3rd Qtr. *484,420*	4th Qtr. *221,160*
Milk Sales	478,325	10,364	150,865	186,805	130,292
Calf Sales	6,000	3,000	3,000	0	0
Cow Sales	22,400	1,600	1,600	3,200	16,000
Total Receipts	506,725	14,964	155,465	190,005	146,292
PAYMENTS (€)					
Dairy Feed	20,280	1,365	9,930	0	8,985
Dairy Feed (Forage)	10,000	0	0	10,000	0
Fert. & Lime	29,196	6,048	9,072	14,076	0
Vet	22,412	5,620	7,410	4,723	4,660
AI/ Breeding	11,000	0	9,000	2,000	0
Contract rearing	58,045	8,743	16,558	16,372	16,372
Contractor (Silage)	17,200	0	6,000	11,200	0
Contractor (other)	22,810	4,360	8,150	7,650	2,650
Bark mulch	16,200	2,200	6,000	4,000	4,000
Seed & Spray	1,000	0	1,000	0	0
Milk Rec. & Parlour	11,590	1,362	4,543	4,323	1,362
Polythene & Additive	350	0	0	350	0
Levies & Transport	2,975	2,150	150	0	675
Straw	400	400	0	0	0
Sundry V. Costs	4,500	0	1,500	1,500	1,500
Labour	92,532	23,383	24,383	23,383	21,383
Machinery	5,700	800	2,300	800	1,800
Jeep	3,600	1,350	750	750	750
ESB	6,900	1,300	1,500	2,900	1,200
Phone	1,110	300	270	270	270
Repairs & Maint.	5,000	1,000	1,500	2,500	0
Insurance	6,040	5,490	0	0	550
Professional Fees	3,100	0	0	0	3,100
Interest Payments	24,800	6,200	6,200	6,200	6,200
Land Lease	52,798	26,399	0	26,399	0
Staff Costs	4,500	450	1,350	1,350	1,350
Total (€)	434,038	98,919	117,566	140,746	76,807
Total Expenditure (€)	434,038	98,919	117,566	140,746	76,807
Net Cash Flow (€)	72,687	-83,955	37,899	49,258	69,484
Current A/C Bal (€)	72,687	-83,955	-46,056	3,202	72,687

Table 3. Physical performance of the Greenfield Dairy Farm to May 2011

		Jan	Feb	Mar	Apr	May
Farm	Milk deliveries (L)	493	26,712	99,141	185,872	173,264
	Protein (%)	3.35	3.52	3.48	3.32	3.25
	Fat (%)	4.00	4.29	4.49	4.26	4.20
	Milk solid (kg)	37	2149	8,139	14,511	14,805
	Somatic cell count	175,000	175,000	171,000	134,000	130,000
	Cow mortality	2	0	1	0	1
	Calves born	21	130	119	46	10
	Calves mortality	5	4	4	2	1

A total of 70 kg of concentrate and 100 kg DM of whole crop silage were fed per cow over the spring. The whole crop silage was surplus feed on the farm from the previous winter. Grass growth was below normal in spring; average grass production was 4.0 t/ha to the end of May. Approximately 30 ha were harvested as pit silage in early June. Based on current performance it is expected that the farm will generate substantially higher surplus cash than projected.

CONCLUSIONS

The Greenfield Dairy Farm has gone through the set up phase and is currently in Year 2 of production. Farm development has moved to Year 5 as defined in the original plan for the farm. The farm has performed ahead of schedule for the first 5 months of 2011 and it is expected that there will be significant cash surpluses generated from the farm in 2011.

PRODUCING HIGH QUALITY MILK

It makes cents to reduce SCC

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SUMMARY

- Reducing herd SCC from 350,000 cells/ml to 150,000 cells/ml is worth €133 net profit/cow/annum.
- CellCheck is an Animal Health Ireland-led mastitis control programme.
- Collaboration between government, producers, processors and service providers.
- Based on agreed, clear consistent messages around mastitis control.
- Most important step in mastitis control is good post-milking teat disinfection.

INTRODUCTION

High bulk tank somatic cell count (SCC) is often seen as something outside farmers' control, something that has to be "put up with". However, this doesn't have to be the case. The financial gains to be made from improved control of mastitis are substantial and often forgotten about. It is easy to quantify payment penalties incurred, lost bonus payments and the cost of dealing with clinical cases of mastitis. However the greatest, and often unseen cost of mastitis, is the production loss that results from subclinical infection. Cows with high SCC are not yielding to their full potential, mainly due to damage and loss of milk secretory tissue in the udder. Recent Teagasc research has shown that if the herd SCC is reduced from 350,000 cells/ml to 150,000 cells/ml, the net profit per cow increases by €133/annum. The culling costs associated with chronically infected cows are also hugely significant.

WHAT CAN WE DO?

CellCheck is the national mastitis control programme led by Animal Health Ireland, and supported by and developed in partnership with Teagasc and other industry stakeholders. These stakeholders include government, producers, processors and service providers such as Teagasc. The CellCheck programme is based on the principles of building awareness, delivering best practice, setting standards and building capacity to control mastitis. Currently a wealth of knowledge exists within the dairy industry in relation to mastitis control. There has been a need however, to collate this knowledge into a single resource accessible to all. AHI has convened a technical working group (TWG) whose role is to collate Irish and international expertise and research in mastitis control. This will produce agreed, clear and consistent messages and guidelines, which are independent and evidence-based. The initial output from the CellCheck TWG is being delivered to the industry through monthly news topics. These articles appear in the Irish Farmer's Journal on the first week of each month, and are also being disseminated through co-op newsletters, Teagasc client newsletters etc. All monthly news topics, along with other CellCheck information can be found on www.animalhealthireland.ie.

TIP TOP TEATS

Reducing the bacterial load on teats, and keeping teat skin in tip top condition.....these are the reasons we carry out teat disinfection. Mastitis occurs after bacteria enter the udder through the end of the teat. It's a numbers game – if you minimise bacteria near the teat ends, you minimise infections. Disinfecting teats is a proven way to control contagious bacteria such as *Staph aureus*. Research also shows that it significantly reduces new infections caused by environmental bacteria such as *Strep uberis*. Milk from quarters with mastitis contains bacteria that may contaminate the skin of many other teats during milking. Bacteria in milk from an infected cow may be found on the liners and transferred to the teat skin of the next five to six cows that are milked with that cluster. Once on the teat skin, they multiply (especially at sites of teat cracks/sores) and infect the quarter through the teat opening. Healthy teat skin is easier to keep clean and has fewer locations for bacteria to grow, so it makes sense that post-milking teat disinfection is vital to control mastitis caused by environmental bacteria. Teat disinfection should be carried out on every teat, after every milking, for the entire lactation.....it's not just a winter sport! It is important to choose the product you use carefully. Don't make a snap decision to change at the moment you purchase a new drum. Use a good quality licensed product that contains emollient for optimum skin condition. If you find that teat skin condition is poor at certain times of year, don't stop teat disinfecting. Consider changing your product temporarily instead. For example, in bad weather if teats are chapped you might need to use a product that contains a higher level of emollient. Don't base your decision on price alone.

IS THE DRIP OF SPRAY AT THE TIP OF THE TEAT ENOUGH?

You won't gain the milk quality and financial benefits of teat disinfection if the spray only reaches the tip of the teats. The teat must be completely covered, from the top to the tip. Failure to cover the whole teat of every cow at every milking is the most common error in teat spraying. All benefits of correct product selection, preparation and handling are lost if the disinfectant doesn't reach every area of the teat skin that's been touched by the liner. When teat spraying, at least 15ml of disinfectant per cow per milking is needed to achieve good coverage (or 10ml in the case of teat dipping). The spray equipment and the operator's technique both make a big difference to efficiency and effective coverage:

- » Choose equipment that will spray an even cover of fine droplets to about 10 cm diameter when sprayed vertically from about 10 cm distances. Check the spray pattern regularly by spraying onto a piece of paper. Hollow or "doughnut" patterns are not satisfactory.
- » Regularly assess the coverage achieved and encourage milking staff to do the same - assess each other too. Simple checks for coverage include:

a. looking at teats after spraying – it can help if you use a product that's clearly visible on the teat skin after it's been sprayed on. All sides of the teat barrel should be covered.

b. wrapping a paper towel around the barrel of the teat, then carefully removing and examining the pattern. A patchy picture indicates poor coverage of the teat, while a "solid" block means teats have been well covered.

c. calculating the volume used per milking. For example, if you use 3 litres (or 3,000ml) of disinfectant a day, and are milking 100 cows:

$$\frac{\text{3,000ml/day}}{\text{100 cows x 2 milkings/day}} = \text{15ml/cow/milking}$$

CONCLUSIONS

A wealth of knowledge exists around mastitis control. CellCheck is providing agreed, clear and consistent messages and guidelines, which are independent and evidence-based. One of these clear messages is that post-miking teat disinfection is one of the most effective cell count and mastitis control measures available. However, it needs to be done well if we want to get maximum reward for our efforts.

Guidelines for effective cleaning of milking equipment

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SUMMARY

- Effective cleaning of equipment will be determined by the product you choose and how it is used.
- The stain of 'caustic only' cleaning products should be left on equipment surfaces between milkings for effective cleaning.
- Detergent-sterilizer products should be rinsed from the milking system immediately after the main wash cycle.
- The lowest bacteria numbers in milk and on equipment surfaces were achieved with acid washing as part of the daily wash routine.
- The concentration of thermoduric bacteria transmitted to milk is influenced by the amount of dirt on teats.

INTRODUCTION

In order to minimize total bacterial counts and thermoduric counts in bulk milk and to avoid chemical residues the following guidelines for detergent use and cleaning practises should be considered.

CHOOSING A PRODUCT

Choose products that are adequately labelled with name of manufacturer, PCS number (this indicates it is legally registered for use on farms), identity of active substances, directions for use, optimum temperature usage, expiry date and batch number. Use detergent levels as specified by the manufacturer. Avoid stock piling detergent-sterilizer products as the expiry date generally is six months from the date of manufacture. A detailed list of the chemical analysis of products sold in Ireland and guidelines for best use is available on the Teagasc website (www.agresearch.teagasc.ie/moorepark/).

DETERGENT-STERILIZER PRODUCTS (CONTAIN CHLORINE)

If you intend to re-use the detergent for one subsequent wash choose a detergent-sterilizer with a caustic concentration greater than 10 per cent (working solution >800ppm) and a chlorine concentration less than 4 per cent (working solution 200 to 320ppm). Products with lower caustic concentrations are satisfactory if solutions are not recycled and if hot water is used for each wash. Detergent-sterilizer products ideally should be used with hot water (9 litres/unit) at a minimum of 70^{0}C, at least once daily. The solution should be rinsed from the milking system with clean water (14 litres/unit) immediately after the main wash cycle to avoid any possible milk residues. A small number of powder products contain chlorine and immediate rinsing after the main wash cycle is also required in these circumstances. A weekly milk-stone remover (acid detergent) wash is an essential part of any wash routine and is required to remove mineral deposits from equipment.

LIQUID/POWDER CAUSTIC PRODUCTS (NON-CHLORINE)

Liquid caustic products have been developed which facilitate the automatic cleaning of milking machines and bulk tanks. The main principles of cold cleaning apply to both the powder and liquid products. It is very important **not to rinse the caustic solution stain from the plant until immediately before the next milking** as successful cleaning and bacterial killing power depends on prolonged contact time with the plant surfaces. A working solution greater than 2000ppm is recommended for non-chlorine cold caustic cleaning products. Most of the powder and liquid caustic products on the market make sufficiently strong solutions if used as recommended. Cold circulation liquid or powder products may be used with hot water; in those circumstances lower usage rates may be used as recommended by manufacturers. The new liquid products contain much lower levels of caustic than powder products. Therefore the re-using of these products needs further investigation. Weekly acid cleaning is a minimum requirement when using cold circulation products. Recent trials at Moorepark observed the lowest bacterial numbers in milk and on equipment surfaces when acid washing (descaler) was included in the wash routine to replace the detergent-sterilizer for the evening wash.

STERILIZING THE MILKING PLANT

Peracetic acid is an antimicrobial disinfectant used for sterilizing milking equipment. The use of peracetic acid in the final rinse water as an alternative to chlorine may be beneficial in situations where water quality is in question and where cold circulation cleaning is practised. Daily use of peracetic acid in the final rinse water will prevent biofilms forming on equipment especially in the case of hard water. Before adding peracetic acid to the final rinse water the detergent wash solution should be rinsed from the plant with clean water to avoid any chemical contact between detergent and acid.

THERMODURIC BACTERIA (BACILLUS CEREUS)

The shelf life of pasteurized dairy products depends partly on the concentration of thermoduric spores in raw milk. The two main sources of thermoduric bacteria are the environment and the milking machine. When clusters are attached to teats for milking thermoduric bacteria gain entry into milk. Inadequate cleaning of equipment and maintenance of rubber-ware will facilitate the multiplication of these bacteria in milk.

The spore concentration in bulk tank milk is directly related to the contamination of teats with soil. Lower and higher spore levels on teats could be expected during periods of hot and wet weather, respectively. When cows are indoors, poor quality silage and cubicle bedding material are also a likely source of teat contamination. Maintain clean tails and udders with regular clipping. In addition, clean approach roads and collecting yards. Research at Moorepark has shown the most effective method to reduce the spore count in milk is washing teats followed by drying with a dry paper towel. Spraying teats with disinfectant followed by drying with paper towels prior to milking will reduce bacterial counts on teats. Cleaning teats with dry paper towels for a period of 10 seconds can reduce concentrations of spores by 50 per cent. The number of bacteria on milk liners represents a cumulative build-up of dirt and bacteria from the teats of cows milked by that unit. Flushing clusters with water and disinfectant between individual milkings will help prevent the transfer of bacteria from cow to cow and maintain a clean milk liner. Poorly cleaned and maintained milking plants, particularly where milkstone and perished rubber-ware are present, have been identified as significant sources of spore-forming organisms. Effective use of detergents, acid descaler's and hot water as outlined above will maintain equipment in a hygienic condition. Rapid cooling of milk to below 4^0C also greatly contributes to the quality of milk on farm.

CONCLUSION

To minimize bacterial counts and avoid chemical residues in bulk milk, present clean cows for milking and follow washing guidelines on detergent selection and appropriate use of products.

Reducing trichloromethane (TCM) levels in milk

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SUMMARY

- Trichloromethane (TCM) residues develop in milk due to interaction between chlorine (in the milking machine/bulk tank cleaning process) and milk.
- TCM levels in Irish butter have always been well within legal requirements (0.10 mg/kg but European competitors require levels of 0.03 mg/kg).
- TCM in milk is concentrated in the fat fraction during butter manufacture.
- To maintain a dominant position in the market, TCM levels in butter must be reduced to 0.03 mg/kg, which means reducing TCM levels in milk to <0.002 mg/kg.

INTRODUCTION

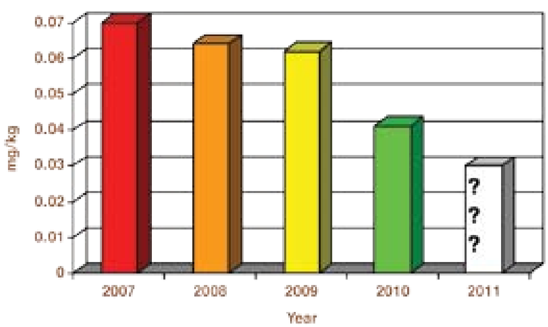
Irish Butter sold in the EU is hugely important to the Irish Dairy industry. A premium price is received for Irish Butter because it is considered a premium product on the basis of its rich yellow colour, its relative ease of spreading and its fresh flavour. However to maintain a position of dominance in the market, the product must meet all quality criteria and be able to compete favourably. Trace levels of Trichloromethane (TCM) have been detected in Irish butter by some consumer groups. Therefore, TCM levels need to be reduced in order to maintain a dominant position within the marketplace.

The development of TCM arises from cleaning and disinfecting procedures that involve the use of chlorine containing products. Chlorine is one of the most effective, efficient and economical substances that can be used to kill or remove bacteria from milking machine and bulk tank surfaces. Cleaning procedures that utilise chlorine detergents can be used, BUT they must be used CORRECTLY and CAREFULLY.

PROGRESS ON REDUCING TCM

The Dairy industry and Moorepark has worked since 2007 to identify and develop strategies for TCM reduction. Significant progress has been made. TCM levels in butter have been reduced by approximately 40 per cent and average levels for 2010 were 0.04 mg/kg. It is now necessary to further reduce TCM levels to $\leq$ 0.03mg/kg, which would mean elimination of almost all chlorine residues in milk.

Figure 1. Can TCM be reduced to 0.03mg/kg in Irish butter in 2011?



CURRENT SCREENING OF TANKER MILK AND INDIVIDUAL SUPPLIER MILK FOR TCM

Milk from individual suppliers are tested for TCM and problem milk with high TCM are re-tested until TCM reaches an acceptable level of < 0.002mg/kg. A total of 12,250 milk samples have been tested for milk processors in 2010. A rapid testing mechanism was put in place in late 2010 and it is anticipated that approximately 25,000 samples will be tested in 2011.

Dilution effect: Milk from 1 supplier that is high in TCM when added to a milk tanker load with acceptable TCM level (less than 0.002mg/kg in milk) can result in all of the milk in that load being measured as high in TCM (greater than 0.002 mg/kg)

ENSURING LOW TCM LEVELS ON YOUR FARM

» Check that an appropriate detergent product is used for both machine and bulk tank cleaning - see Teagasc list of tested products: http://www.agresearch.teagasc.ie/moorepark/Articles/Chemicalanalysisofdetergentsterilizerproducts.pdf

» Is measuring equipment (e.g. jug, pump) used to measure correct quantities of chemicals?

» How many times is the detergent solution re-used? The solution should only be re-used once

» Check if additional chlorine products are added daily to main wash detergent

» Check volume of rinse water used to rinse out milk (pre-wash rinse cycle) and detergent (post wash rinse cycle) residues. The recommended volume is 14 l/unit /milking unit

» Is the water from the post wash rinse cycle retained and stored for re-use. Rinse water should never be re-used

» Ensure the milking plant drains properly after each wash /rinse cycle

» Check if chlorine is added to final rinse water. If yes, the maximum level used should be 14 ml/45 litres

» If the TCM problem is tank related and correct type and volume of detergent is used, then increasing the bulk tank rinse cycle time may correct the problem

» Dipping clusters in chlorine between cow milkings should be avoided - peracetic acid may be used instead of chlorine

» Implement changes/adjustments to the system and re-sample bulk milk tank at earliest convenience to confirm that the actions were successful

CONCLUSION

TCM levels in butter have been reduced by approximately 40 per cent and average levels for 2010 were 0.04 mg/kg. Success to-date has been due to joint co-operation between milk producers, milk processors and Moorepark. The current target is to reduce TCM levels to 0.03mg/kg in butter and <0.002mg/kg in milk in 2011 in order to maintain a dominant position in the marketplace.

Increasing milking efficiency

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SUMMARY

- The milking process is an interaction between cows, people and facilities.
- Measuring performance is the first step on the road to improving productivity.
- Good cow flow is essential at all times.
- As cluster number increases, row time and duration of over-milking increase. The pre-milking routine dictates the number of units one milker can handle.
- Too few clusters can result in operator idle time.

INTRODUCTION

The organisation and management of milking on a dairy farm should be focused on producing premium quality milk from a herd of healthy cows. Labour input level must be reasonable and practical, while being profitable for the dairy farmer. In order to achieve this, all stages of cow movement and the milking facility itself must be critically examined by the operator/manager. This includes the herding procedures, parlour entry and exit, milking plant size and design and all associated facilities.

Choice of milking infrastructure: There are five main questions that should be asked when designing a new parlour or expanding an old parlour: how many cows are to be milked; what milking time is expected/acceptable; what will be the predominant pre-milking routine; what level of automation is desired; and what is the capital expenditure required/available. This will determine parlour type, size and design.

KEY TARGETS REQUIRED FOR SATISFACTORY MILKING:

Efficient cow movement into the parlour: *Good cow flow into the parlour is critical for efficient milking. The cows must not be conditioned into waiting for the milker to usher them in. Tapering of the yard into the parlour entrance aids cow entry. A backing gate can assist with cow-flow into the parlour but it needs to be well designed, operated from various points along the milking pit and moved frequently.*

Milking: Teat cups should be attached in a quick and efficient manner to minimise air admission into the system. Milking should cease at the correct time to prevent under or over-milking, i.e. usually an end flow rate of ~200 ml/minute. If clusters are removed manually, milkers need to have enough time to reach all cows before significant over-milking occurs. A good exit gate must open and close quickly, be easy to operate and be controlled from any point in the pit. Drafting should be possible without the milker leaving the pit.

Performance indicators: Common performance measures of the milking process include cow throughput, milking labour productivity and clusters managed/operator. Survey data from Irish and Australian farms have indicated typical values for these parameters, which are outlined as follows: cow throughput (cows/operator/hour) ranges from 20-140 (median farm = 65 and top 25 per cent of farms at 80 cows/operator/hour upwards); milking labour productivity (litres/operator/hour) ranges from 300-2,100 (median farm = 650 and top 25 per cent of farms at 1200 litres/operator/hour upwards); clusters managed/operator ranges from 5-20 (median farm = 10 and top 25 per cent of farms at 12 clusters/operator upwards).

RECENT RESEARCH STUDY CONDUCTED AT MOOREPARK

The effect of milking cluster number, pre-milking routine and stage of lactation on milking row time and over-milking were measured in a one-person milking process. As cluster number increased, row time and duration of over-milking were increased. The type of routine practiced largely dictates the number of clusters one operator can handle and the overall efficiency of the milking operation (Table 1). A minimal pre-milking routine (no teat preparation) applied efficiently allows up to 22 milking units to be operated without experiencing over-milking. However, up to 26 units may be managed if automatic cluster removers (ACRs) are in place. Alternatively, when a full pre-milking routine (wash, dry, fore-milk) is applied throughout lactation, just 14 milking units (early lactation) or less (late lactation) may be operated without experiencing over-milking in the absence of ACRs.

Table 1. Effect of pre-milking routine, unit number and stage of lactation on milking row time and duration of over-milking

Number of Milking units	Stage of Lactation	Row Time (min)		Over-Milking (min)	
		Full	Minimal	Full	Minimal
14	Early	11.1	9.2	2.1	0.8
	Late	9.1	7.5	3.3	0.9
18	Early	13.3	10.4	3.7	1.2
	Late	11.9	7.8	4.6	1.3
22	Early	16.0	12.0	5.4	2.0
	Late	15.0	9.5	6.8	2.2
26	Early	19.0	11.8	7.1	2.1
	Late	17.2	10.4	8.7	3.5
30	Early	21.1	12.9	9.3	2.9
	Late	19.7	11.9	10.4	4.7

Using the row times measured in the Moorepark study and assuming a maximum row number of 10, a one-person milking operation with 22 units and a minimal pre-milking routine would allow a 220 cow herd to be milked in 2 h and 1.6 h in early and late lactation, respectively, (e.g. 10 rows, 9.5 min milking row time). A 26-unit milking system with ACRs, also with a minimal routine, would allow a 260-cow herd to be milked in 2 h and 1.7 h in early and late lactation respectively (e.g. 10 rows, 11.8 min milking row time). Alternatively, a 14 unit, one-person operation using a full pre-milking routine would allow 140 cows to be milked in 1.9 h at peak lactation (e.g. 10 rows, 11.1 min milking row time). However, some modification would be required in late lactation to prevent over-milking, e.g. ACRs or a lower unit number.

CONCLUSION

Careful planning of new or extended parlours can save time and money. Automation should be used when it saves time, manual labour or running costs. Increasing milking unit number can reduce overall milking time but is limited by the increase in row time. This is influenced by both pre-milking routine and stage of lactation, which, in turn, influences cow over-milking. These results have implications for milking management generally, and particularly in seasonally calved herds.

Increasing energy efficiency on dairy farms

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SUMMARY

- The average cost of electricity measured on 21 commercial dairy farms in 2010 was 0.43 cent per litre. There is large variation in energy costs on dairy farms, from 0.23 cent per litre up to 0.76 cent per litre.
- The main drivers of energy consumption on dairy farms are milk cooling equipment and the requirement for hot water, which is dictated by the number of milking units and the level of automation on the milking machine.
- Plate cooling milk to within 3°C of incoming water temperature will reduce cooling times. As a result it is possible to cool a higher percentage of the morning milking on night rate electricity.

DRIVERS OF ENERGY CONSUMPTION

Data collected from 21 commercial dairy farms in 2010 as part of the DairyMan project is summarised in Figure 1. Detailed energy audits were carried out on these farms from May to October 2010 to quantify the electricity consumption attributed to the dairy and milking operations. There was a large variation within the group in terms of herd size (46 to170 cows) with an average of 106. Milking parlour size varied from 8 units to 20 units with contrasting levels of automation and management practices. These variations led to a wide range in both energy consumed per litre of milk produced (from 9 to 22 Watts / litre) and cost per litre (from 0.23 to 0.67 cent/litre).

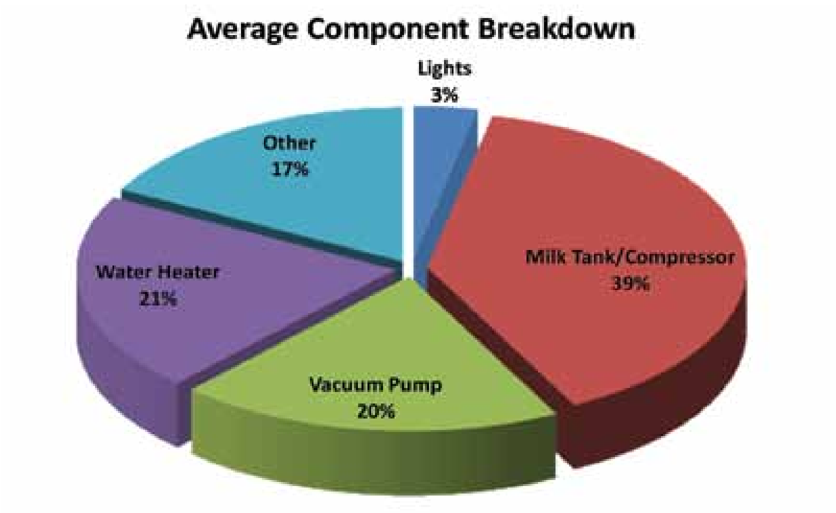

Figure 1. Average component consumption on 21 commercial dairy farms

1. Milk cooling: Typically the cooling process is completed in two stages; pre-cooling and refrigeration. Pre-Cooling is achieved by passing the hot milk through a Plate Heat Exchanger (PHE) before entry to the bulk tank. Cold water is pumped through the opposite side of the PHE. The goal of pre-cooling is to bring the milk temperature as close as possible to that of the water which can vary from 7°C to 15°C depending on the source and time of the year. PHE manufactures recommend milk to water flow ratios of between 1:2.5 and 1:3 depending on the model. If a PHE is sized correctly in relation to the output of the milk pump and the correct ratio of water is supplied then the power consumed during the refrigeration stage can be reduced by up to 50 per cent. This could amount to a saving €700/year for a 100 cow farm. Some of the benefits of pre-cooling will be undone if the bulk tank cooling unit is not installed and maintained properly.

2. Water heating: Farmers should be aware that with enlarged milking parlours and increased levels of automation come higher running costs due to the greater requirement for hot wash cycles. Generally, a minimum hot water requirement is nine litres of 80°C water per milking unit for each hot wash cycle plus a reserve for bulk tank washing. Treating water for hardness and insulating hot water tanks and pipes are essential for improving the efficiency of water heating systems. Using night rate electricity instead of day rate electricity will reduce the price of producing 100 litres of hot water from €1.77 to €0.87. Night rate is charged at €0.0745 per kWh and day rate is charged at €0.1506 per kWh therefore it is strongly recommended to use night rate electricity as much as possible. Night rate hours are from 11pm to 8am during winter time and 12 midnight to 9am for summer time. Oil fired boilers have the advantage of quick recovery times and are an option where hot water usage exceeds 300 litres per day. Oil fired boilers can produce 100 litres of hot water at a cost of €0.75 (oil price €0.82/litre 25/05/2011).

3. Vacuum pumps: International and Irish Milk Quality Co-operative Society (IMQCS) standards are a basis for installing a new milking machine. New revisions of these standards were introduced in 1989, 2004 and 2008. Changes that have been implemented include an increase in recommended vacuum pump capacity for a given size of milking machine. This is because modern milking machines require a large vacuum reserve for washing. However during milking the plant consumption is a fraction of the vacuum pump capacity resulting in large amounts of air being drawn in through the regulator. Addition of a variable speed drive (VSD) to the vacuum pumps of these large modern milking machines can result in savings of over 60 per cent on vacuum pump running costs which would be a saving of €410/year for the average 100 cow farm. The VSD is able to adjust the rate of air removal from the milking system by changing the speed of the vacuum pump motor. Most milking machine manufacturers offer VSD vacuum pumps as an optional extra.

CONCLUSION

The first step to reduce energy costs is to eliminate energy wastage i.e. fix hot water leaks, insulate hot water piping and refrigerant gas piping and using lights only when necessary. Using night rate electricity, particularly for water heating, can dramatically reduce energy costs. Improving plate cooling may require some investment in increased pipe sizes or well pump capacity but significant savings are possible. The benefits of reducing electricity consumption are two fold. Reducing milk production cost is an obvious benefit but also 531g CO_2 are produced for every kWh of electricity used. Hence reducing electricity consumption will also reduce the industries carbon footprint.

ACKNOWLEDGEMENTS
The support of the Dairy Levy Research fund and INTERREG IVB North-West Europe through the DairyMan project is gratefully acknowledged

Automatic milking at Moorepark

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SUMMARY

- One cow is milked at a time in a single stall AMS and milking is conducted over a 22h period per day.
- Cows must volunteer for milking, i.e. must walk from paddock to AMS unit.
- A significant portion of operator labour is converted from physical work to cow and data management.
- Correct grass allocation is critical to optimise cow visits for milking.

INTRODUCTION

The defining feature of an automatic (robotic) milking system (AMS) is that cows decide when they wish to be milked. With the AMS, all of the functions of milking and associated cow management are automated and cow milking is distributed over a 22h period. There are approximately 10,000 AMS units operating on commercial farms with small herds using indoor-based production systems and year-round milking, mostly in Northern Europe. Research on AMS in New Zealand has indicated that the AMS is applicable in a pastoral, seasonal system of milk production, particularly with smaller herds. A small number of commercial farms in Australia and New Zealand currently have AMS units.

IS AMS TECHNOLOGY RELEVANT TO IRISH DAIRY FARMS?

The concept of automatic milking could be very relevant to dairy farming in Ireland. There is an anticipated increase in national milk production by 50 per cent in the coming years. However, at the same time, land as a resource is limiting and the quantity and quality of skilled labour are in increasingly short supply. There are a number of fundamental questions being asked on dairy farms at present, e.g. how to expand a dairy herd on a fragmented land base, farm organisation in order to maintain a simple production system and the choice between hired labour versus automation.

INVESTIGATIVE STUDY OF AMS AT MOOREPARK

Due to increasing interest from dairy farmers, it was decided to establish a scientific evaluation of AMS in an Irish dairy research scenario. This study would assemble information, such as the resources required for AMS, set-up issues, capabilities and outputs. This research will investigate whether the concept presents a realistic alternative to conventional milking systems in Ireland. This study has been made possible by the Fullwood Packo Group who have sponsored the required milking, cooling and associated equipment for a period of three years.

AMS PROJECT START-UP

The farm-let associated with the AMS consists of a 24 ha milking platform. There are currently 62 cows in the system (target 80 cows) with a mean calving date of 15th February (range 1st February-15th March). The staff involves one full-time farm staff member at present. The land area is divided into three grazing sections of eight ha each (A, B, C) which are further divided into one ha paddocks. Four main roadways radiate from the centrally located dairy. Drinking water is located at the dairy. Maximum distance to furthest paddock is ~ 400 m. The dairy features one Merlin AMS unit installed adjacent to the existing shed. The infrastructure incorporates a pre-milking waiting and post-milking area. There are three drafting units, two positioned at the entrance to the dairy that draft cows to the pre- or post- milking area depending on readiness for milking, a third positioned at the dairy exit which drafts cows to the holding yard (for treatment or inspection) or to grazing (Section A, B, C). Automatic milk diversion (colostrum, antibiotic) is included and extensive milking and cow information recorded at each milking (e.g. milk yield, milking time, milk flowrate, SCC, live-weight, concentrate dispensed). The system has potential generator power back-up at all times.

Critical start-up issues include: (a) cow selection on udder and teat conformation, (b) cow training takes approximately four days, (c) 0.5 h and 0.25 h to be set aside for routine maintenance checks at morning and evening time every day, (d) liners have to be replaced at three-weekly intervals at this stage (early/mid) of lactation, (e) a daily data check to ensure milking of all cows, udder health and overall cow health and (f) good backup service (William McNamara, Fullwood, for the Moorepark AMS).

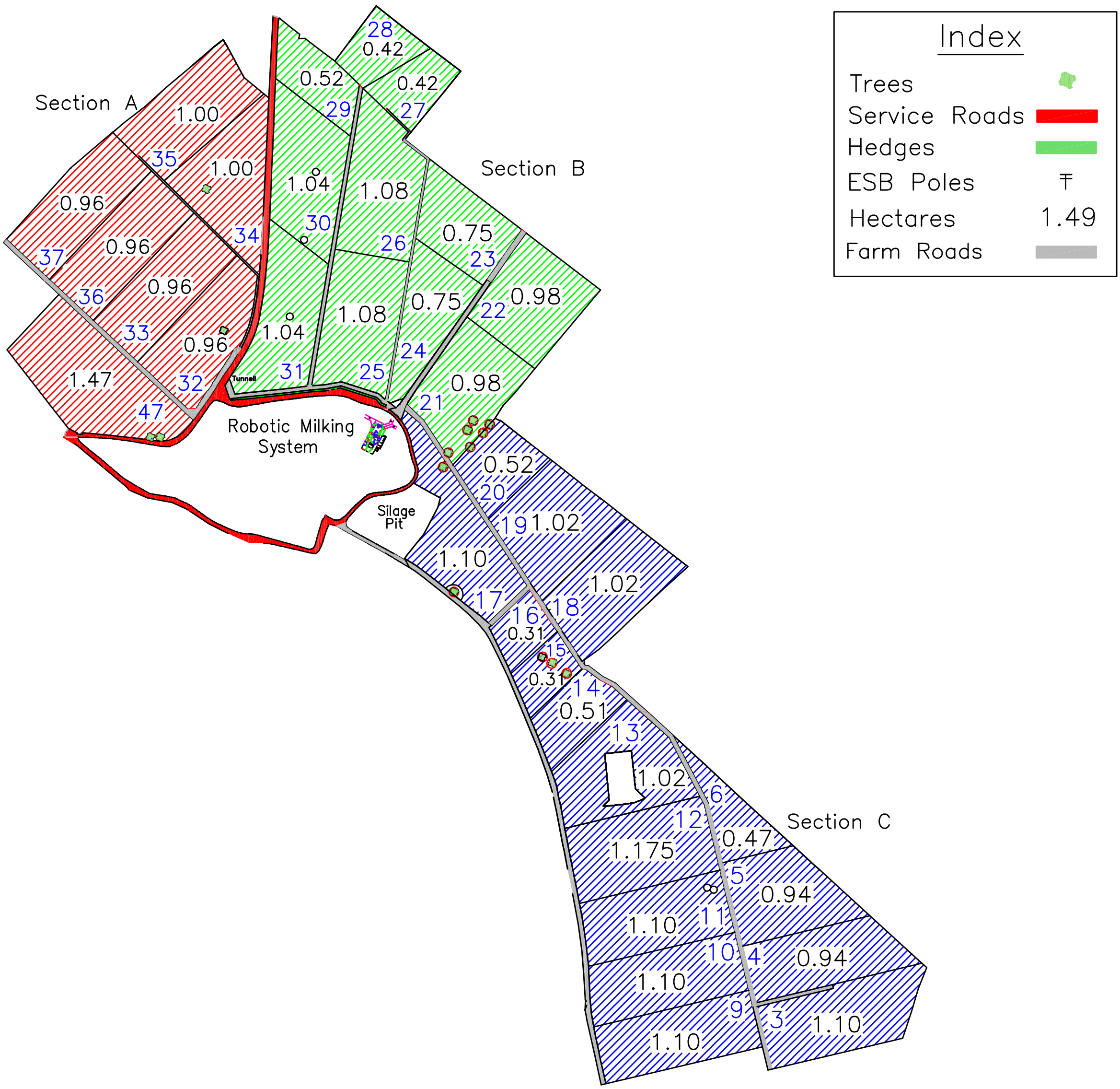
GRASSLAND MANAGEMENT ON A FARM WITH AN AMS

The grass allocation is critical to encourage optimal cow visits to the AMS unit (it can cause cow visit to be too frequent or infrequent). Cows graze defined areas or portions of each of the three grazing sections during each 24 h period. Cows are allocated 5 kg DM in each of the three grazing sections (A, B and C) over each 24 h period. Cows move between the grazing Sections A, B and C at 1 am, 11 am and 5 pm, respectively. Cows are currently going into grazing areas with grass covers of 1400-1500 kg DM/ha. Pasture mass is estimated twice weekly. Covers greater than 1500 kg DM/ha would discourage cow movement to the AMS unit and may reduce milking frequency. Cows are grazing to a post-grazing height of 3.5-4.0 cm. Cows are stocked at an average target of 3.5 cows/ha. All cows receive 2 kg concentrate feed per 24 h period.

CONCLUSION

The objective of this study is to integrate an automatic milking system (AMS) into a cow grazing system where milk output from the AMS unit and the proportion of grass in the cows diet are both maximized. The AMS unit and associated infrastructure is now in place and cows and personnel have been trained in AMS usage and management. Data on cow milk yield/day, milking rate (kg/min), milking interval (h), milkings/cow/day, AMS utilisation, visits/cow/day, time off pasture, cow grazing and grass quality is currently being assembled. Data on production costs, energy, water and detergent usage, milk quality, labour input and cow behaviour will also be monitored.

ROBOTIC MILKING SYSTEM



IMPROVING ENVIRONMENTAL SUSTAINABILITY

Greenhouse gas emissions from dairy systems

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SUMMARY

- EU commitments oblige Ireland to reduce greenhouse gas emissions by 20 per cent below 2005 levels by 2020.
- Methane from cows and nitrous oxide from nitrogen fertilizers are the major sources of greenhouse gas emissions from grass-based milk production.
- Dairy producers can reduce greenhouse gas emissions by adopting management practices that increase the efficiency and profitability of milk production.

INTRODUCTION

Ireland's agricultural sector emitted 28 per cent of the nation's total greenhouse gas (GHG) emissions in 2009. Approximately 33 per cent of agricultural emissions arise from milk production. As an EU member state, Ireland is committed to reduce national GHG emissions to a level 20 per cent below those of 2005 by the year 2020. However, milk production in Ireland is forecast to increase with the abolition of EU milk quotas in 2015. Thus, the dairy industry is currently faced with the challenge of meeting an obligation to reduce GHG emissions, while increasing milk production to satisfy growing demand.

GREENHOUSE GASES IN DAIRYING

Three important GHG arise from dairy production. These are methane, nitrous oxide and carbon dioxide. Greenhouse gases are ranked according to their ability to trap heat and their rate of decomposition in the atmosphere. Known as their global warming potential, this value is expressed relative to carbon dioxide. Unfortunately, methane and nitrous oxide are highly potent and have a global warming potential 21 (methane) and 310 (nitrous oxide) times greater than carbon dioxide. Methane is the predominant GHG emission from Irish dairy production (Table 1). It is produced by cattle when digesting feed and to a lesser extent during slurry storage. The next most important GHG is nitrous oxide (Table 1). Nitrous oxide is primarily emitted when nitrogen fertilizer is applied, and from manure deposited by grazing cattle.

REDUCING GREENHOUSE GAS EMISSIONS

Farm strategies to reduce GHG emissions should not be viewed in isolation. Attempts to reduce emissions from one source may impact upon another, e.g. adding palm kernel oil to diets may reduce methane from cows but increase global GHG emissions from the clearing of rainforests. If GHG emissions are to be reduced within the dairy sector, then the complete production system must be considered. The accepted approach to evaluate GHG emissions from the entire dairy production system is life cycle assessment. The approach considers emissions generated both on and off-farm (GHG emissions associated with the production of purchased inputs e.g. concentrate feed) to fully evaluate mitigation strategies. Previous life cycle assessment work undertaken at Moorepark reveals there is potential to reduce emissions produced from an average Irish dairy farm. Table 1 shows a comparison of 2008 GHG emissions per kg of milk and milk solids (MS) with a forecast emission level for 2018 and the emission level of a high performance target farm.

Table 1. The 2008, projected (2018) and target productivity and greenhouse gas (GHG) emissions from the average Irish dairy production system

	Secorial Average		High
	2008	2018	Performance Target
Milk yield (kg/cow)-delivered 2008	4,661	5,140	5,400
Milk solids (kg fat plus protein)	334	378	450
Protein %	3.34	3.40	3.60
Fat %	3.82	3.95	4.70
Mean calving date	16th March	10th March	20th Feb
EBI (€)	75	110	120
Grazing season (days)	220	245	265
Stocking rate (LU/ha)	1.9	2.1	2.8[1]
Replacement rate %	25	22	18
Herbage Utilised (t DM/ha)	6,378	8,732	15,009
Concentrate per cow (kg)	1,042	750	400
Nitrogen (kg/ha)	148	192	250
Margin per kg MS at 27c/l (€/kg MS)	**-0.07**	**1.00**	**1.95**
Methane (kg CH_4/kg MS)	**0.43**	**0.35**	**0.30**
Nitrous oxide (kg N_2O/kg MS)	**0.015**	**0.014**	**0.011**
Carbon dioxide (kg CO_2/kg MS)	**2.45**	**2.03**	**1.56**
GHG (kg CO_2e^2/kg MS)	**16.06**	**13.53**	**11.50**

[1] A target of 2.8 lu/ha is within the current nitrates derogation limit

[2] CO_2e = global warming potential where methane = 21, nitrous oxide =310, carbon dioxide = 1

The analysis demonstrated that emissions per kg of product can be reduced through full adoption of research technologies in relation to grassland management and genetic merit. Increased genetic selection for profitability using EBI has the most significant effect on reducing emissions per kg of product, followed by increasing grazing season length, and a reduction in N fertilizer application. Key technologies for improving GHG efficiency in milk production include earlier calving, reduced replacement rate, increased milk solids concentration, increased grazing season length, higher stocking rate, inclusion of white clover cultivars to fix freely available atmospheric nitrogen. These changes will result in increased milk solids per hectare, thus having a positive effect on the financial performance of the sector, and hold the potential to reduce current GHG emissions from 16.06 kg to 13.53 kg CO2 equivalents per kg MS produced. In the long term, emissions per kg MS could be reduced as much as 40 per cent from the current national average performance based on current research herds.

CONCLUSIONS

Focusing on the technologies that both reduce GHG emissions and increase farm profitability will result in the maximum gain to the dairy industry. If these changes occur at farm level there could be a significant increase in milk production without significantly increasing the dairy sector GHG emissions. Furthermore, these changes will improve the GHG efficiency or carbon footprint (kg of GHG/kg of MS) of Irish dairy production.

Reducing dairy methane emissions

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SUMMARY

- Digestive methane emissions are being measured to find profitable ways to reduce emissions while maximising milk solids production.
- On-going research is discovering that promoting high pasture utilisation and quality provides immediate opportunities to improve carbon efficiency.
- Methane emission intensity of production does not differ between breeds tested.

INTRODUCTION

Low greenhouse gas (GHG) emissions associated with pasture production compared to cereal crops contribute to Ireland's position as the most carbon efficient milk producer in the EU according to a recent report of the European Commission. The production of 1 kg of Irish cow milk generates on-farm GHG emissions equivalent to 1 kg of CO_2. This is an excellent headline for the dairy sector, but EU targets to reduce GHG emissions remain a significant hurdle in order to achieve the 50 per cent increase in productivity targeted by Harvest 2020. Methane formed during bacterial digestion of feed in the rumen and anaerobic slurry storage is 21 times more potent than carbon dioxide CO_2 and contributes 59 per cent of on-farm emissions. Broadly speaking, the annual digestive emissions from a dairy cow are comparable to a car travelling 9,000 miles. Each will release the equivalent of ~2.2 tonnes of CO_2 into the atmosphere.

MEASURING DIGESTIVE METHANE EMISSIONS

Research to reduce digestive methane emissions per unit of milk produced has been conducted at Moorepark since 2009. Experiments have investigated diet choice, breed choice and pasture management practice. The digestive methane emissions of individual cows are measured using the sulphur-hexafluoride (SF6) tracer gas technique. The technique measures emissions of methane from the nostrils and mouth over 24 hour periods. Cows are dosed with a small calibrated permeation tube that releases trace amounts of SF6 gas at a known rate into the rumen. Cows are then fitted with a Moorepark designed saddle, an evacuated gas collection canister and a flow-restricting sampling line that extends to a point above the nostrils. This innovative design enables sampling from up to 50 cows at a time without interrupting their daily grazing and milking routine. The air sampled from near to the nose and mouth during the 24 hour collection period is analysed using gas chromatography to determine the trace concentrations of methane and SF6 gases. The methane emission of an individual cow is then determined from the relative concentration of methane and SF6 and the known release rate of SF6 from the permeation tube.

OPPORTUNITIES TO REDUCE THE EMISSION INTENSITY OF MILK PRODUCTION

Lactation diet was investigated to assess the methane emissions and milk production response of spring calving Holstein-Friesian cows. The cows were fed to either a grass only diet or a zero-grazed total mixed ration (TMR). Both dietary treatments were applied according to best practice. Grazing was managed for optimum pasture utilisation while the TMR was fed to appetite.

Cows consuming the TMR diet had greater DM intake and produced daily methane emissions 58 per cent higher than grass fed cows. The TMR diet had facilitated higher milk production, however these gains were not sufficient to offset the much higher methane emission. The grass diet reduced methane emissions per unit of milk solids by 15 per cent relative to the TMR during this spring comparison.

Comparison of three different breeds across three different stocking rates has demonstrated that Jersey cows emit less methane than either Holstein-Friesian or Holstein-Friesian × Jersey cows. Methane emissions per unit of milk solids yield, however, was not dissimilar between these breeds. Similarly there was no evidence from the study that cows managed at different SR differ in methane emission per unit of milk solids produced, although cows at high stocking rates (3.0 cows/ha) grazing to lower post-grazing heights did have lower total methane emissions and milk production compared to cows at lower stocking rates (2.75 and 2.5 cows/ha).

In the third study, relationships were found between pasture maturity at grazing and methane emissions per cow, per unit intake and per unit of milk solids yield. Grazing swards at a shorter rotation during the summer (14d vs. 24d) was found to reduce the methane intensity of milk solids production by 14 per cent. Therefore, managing swards to maintain low herbage mass and high leaf:stem ratio may represent a simple yet potentially important tool that can be expected to improve the GHG efficiency of milk production from pasture, particularly during periods of the grazing season when grass plants exhibit reproductive growth.

Further investigation of dietary opportunities to improve the methane efficiency of milk solids production are currently underway. In this years research the effect of concentrate supplementation at pasture and the inclusion of white clover in the sward will be evaluated. Experiments are also underway to improve the tracer gas method used to measure methane emissions.

CONCLUSION

Despite the relative efficiency of Irish milk production a conflict exists between industry expansion and a simultaneous requirement to reduce GHG emissions. Adoption of practices to improve GHG efficiency are required. The on-going research at Moorepark is demonstrating that it is possible to improve the carbon efficiency of milk production through adoption of profitable management practices.

Maximising nutrient use from soiled water

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SUMMARY

- Soiled water from dairy parlours and holding areas offers a substitute for fertilizer N that can cut costs and reduce environmental impacts: a win-win scenario.
- Soiled water contains around 0.6 kg/m^3 N, 0.6 kg/m^3 K and 0.08 kg/m^3 P.
- N in soiled water can achieve 80% of the grass yield of CAN fertilizer.
- Apply at rates of up to 30-45 m^3/ha (2700-4000 gallons/acre) per application.
- Apply from May to August for maximum yields; up to 5 t DM/ha.

INTRODUCTION

Dairy soiled water is a dilute mixture of dung, urine, spilled milk and detergents produced from the washing down of parlours and holding areas that contains nutrients such as N, P and K. With high and unstable fertilizer prices, soiled water offers a substitute for fertilizer that can cut costs and reduce environmental impacts in a win-win scenario.

NUTRIENT CONTENT OF SOILED WATER

A survey of 60 dairy farms over a 12 month period revealed that approximately 10,000 l (10 m^3) of soiled water are produced per cow per year. On average, this contains around 0.6 kg/m^3 N. Roughly one third of this N is rapidly plant-available ammonium-N and the balance is mostly organic N. Soiled water also contains 0.6 kg/m^3 K and 0.08 kg/m^3 P. Therefore, soiled water can also meet some of the P and K requirements on-farm.

Table 1. Nutrient content of soiled water

	kg/m^3	Units/1000 gal.
Total N	0.6	5.4
Rapidly Available N	0.2	1.8
P	0.08	0.7
K	0.6	5.4

FERTILIZER REPLACEMENT VALUE

Plot experiments conducted at Moorepark have demonstrated that soiled water applied during the growing season (February-September) gives 80 per cent of the grass DM yield response of CAN applied at the same level of total N content. Soiled water applied at 22 kg N/ha (roughly 35 m^3 or 3100 gals/acre) could replace 17 kg N/ha of CAN fertilizer while maintaining the same grass production. The soiled water produced on a dairy farm of 100 cows could replace 480 kg of fertilizer N, (1.7 tonnes of CAN), 570 kg of K and 80 kg of P. Assuming costs of €330 a tonne for CAN, €450 a tonne for muriate of potash (50%) and €425 a tonne for superphosphate (16%), this corresponds to cost savings of €575 per year in N, €513 in K and €212 in P; a total cost saving of €1300 per year. In recent years, P and K fertilizer usage has decreased markedly and high N (low P and K) compounds such as 27-2.5-5 NPK have come to dominate, causing concerns about P and K deficiencies. Soiled water can be considered as equivalent to a more balanced 15-2-14 NPK compound fertilizer.

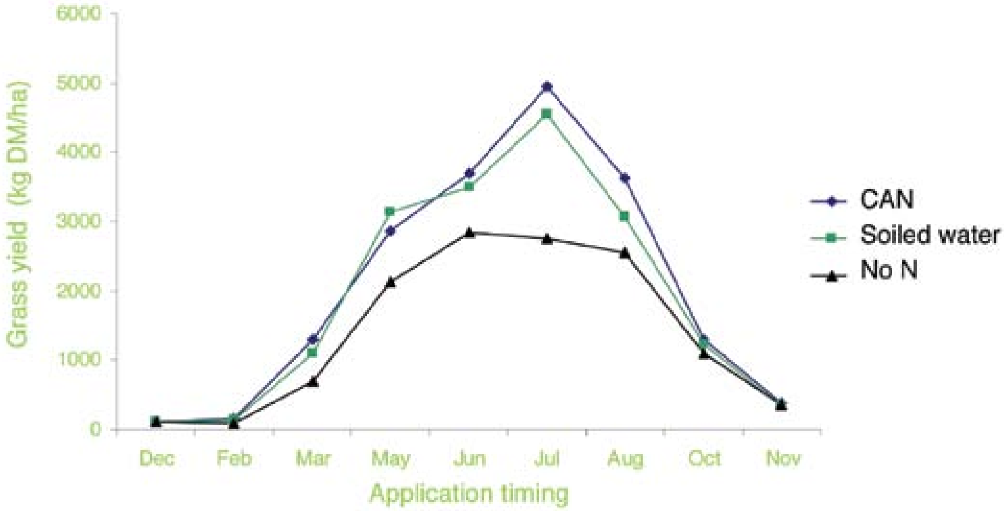

Figure 1. Average grass yield from plots receiving soiled water, CAN or no N at different times of the year. Soiled water and CAN were applied at 15, 22 and 30kg N/ha

STRATEGIES TO MAXIMISE FERTILIZER VALUE

The best yield response to soiled water will be obtained during May to August; the time of peak grass growth potential and N requirement. If you have the capacity to store soiled water through the winter period for application in the spring or early summer, in a clay- or plastic-lined lagoon for example, this can help you get the most out of the N in your soiled water.

Rates of application are limited by the Nitrate Regulations to 50,000 l/ha (4,500 gallons/acre or 5 mm with an irrigator) every six weeks. This amounts to roughly 30 kg N/ha. Application at approximately 20 kg N/ha (roughly 30,000 l/ha or 2,700 gallons/acre) per application may be optimal and can achieve grass yields of 5 t DM/ha at optimum growth times. If fertilizer N is also to be applied to a paddock in the same rotation, apply soiled water a few days before the fertilizer N to avoid the risk of N leaching from the fertilizer.

CONCLUSIONS

Soiled water offers a substitute for fertilizer N that can cut costs and reduce environmental impacts. Soiled water can achieve 80 per cent of the grass DM yield response of CAN fertilizer. Apply soiled water from May to August at 30,000 l/ha (20 kg N/ha) to get the best grass yield response. Managing soiled water effectively to replace fertilizer N, P and K could potentially save €1300 a year on a 100-cow farm.

The Agricultural Catchments Programme Achieving a win/win – better farming, better water

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SUMMARY

- Ways must be found to increase farm output while maintaining or improving water quality.
- The Agricultural Catchments Programme is working in partnership with farmers in six locations around Ireland to achieve this aim.
- Integration of farmer input, advice and research is the basis to the success of the programme.
- Early indications are positive but more data over a longer time frame is required to determine trends in water quality.

INTRODUCTION

Food Harvest 2020 calls for growth in farm production including a 50 per cent increase in milk production. This is based on Smart, Green, Growth, and the Agricultural Catchments Programme (ACP) approach fits well with this. It is aiming to support increased food production while protecting or improving water quality. The framework for the improvement in water quality is laid down in the Nitrates and Water Framework Directives, and Ireland's progress will be judged against the requirements of these EU regulations including the derogation to farm above 170 kg of organic nitrogen per hectare.

OPERATING THE AGRICULTURAL CATCHMENTS PROGRAMME

Ireland's National Action Programme under the Nitrates Directive was drawn up in 2005. New Regulations, called the Good Agricultural Practice (GAP) for Protection of Waters Regulations 2006, have now put the National Action Programme into law. The ACP is an advisory/research programme based on partnership with farmers. It is evaluating the GAP measures which have been implemented under the Nitrates Directive, and developing a deeper understanding of how nutrient losses occur and the socio-economic impacts of the GAP measures.

The ACP works in six intensively farmed catchments ranging from 600 to 3,000 hectares, each based on a stream that drains the entire catchment (Figure 1). The main farming systems (dairy, drystock, tillage) are represented in different catchments, as are a range of soils and landscape types. Care was taken to select catchments where the main risk of nutrient loss was considered to be either nitrogen or phosphorus so that each scenario could be assessed.

The ACP team of researchers, advisors and technicians is working very successfully with farmers, and data on surface water, groundwater, weather, soils, nutrients, economics and attitudes is flowing in through instruments and directly from farmers. This level of detail will allow the ACP to identify any contribution from farming to water quality improvement in Ireland. An improvement in water quality is critical for the renewal of the derogation and the shape of future GAP measures.

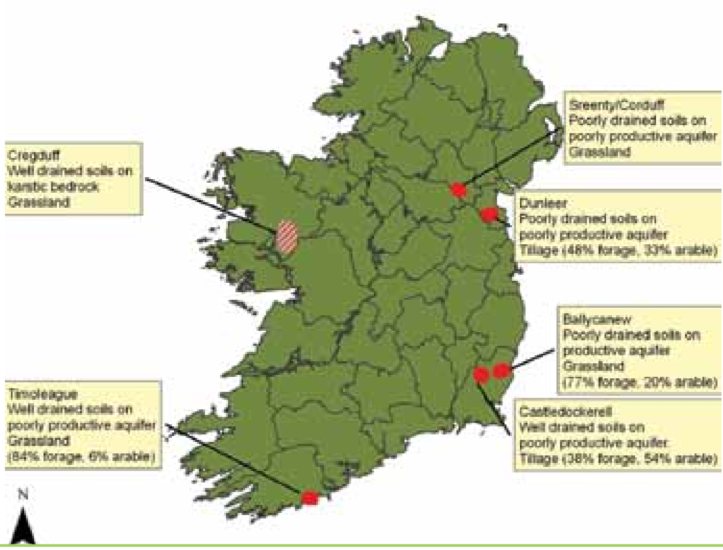

Figure 1. The six Agricultural Catchments Programme catchments

EARLY INDICATIONS FOR THE ACP

More data is required over a longer time to conclusively answer all the questions about the performance of Irish farming in sustaining water quality but some trends are beginning to emerge. These indicate that:

- Derogation farming (e.g. intensive dairying) can be sustained in some areas which are considered high risk for nitrate loss to groundwater.
- The legacy of high soil phosphorus (P) in some fields will take many years to decline before environmental risk is reduced, even where phosphorus spreading ceases.
- P losses are closely linked with soil and sediment loss, especially from poorly draining soils and some tilled land where soil loss may also be a concern in its own right.
- In some karst-limestone areas there may be less risk of diffuse P loss across the whole land surface than was thought; most losses may occur through points that are connected to groundwater channels, e.g. rock outcrops, swallow holes, etc.
- Farms where nutrient inputs and outputs are in balance at farm-scale may hide risky, unbalanced individual fields.

CONCLUSIONS

An improving trend in water quality is needed if Ireland is to comply with EU Directives. Farming is expected to increase output but must do so while contributing to water quality improvement. Current trends in water quality are encouraging but Ireland must demonstrate continued improvement in the future, and farming must be able to show that it is contributing significantly to this trend. The ACP is working with the farming industry towards achieving this aim.

Reducing nitrogen losses using nitrification inhibitors

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SUMMARY

- Reducing fertilizer inputs reduces production costs on farms.
- Preventing nitrate build up in soils improves efficiency by reducing losses.
- Nitrification inhibitors reduce environmental N losses.
- Improved fertiliser efficiency using inhibitors is more pronounced at lower N fertilizer levels.

INTRODUCTION

The steady increase in the cost of N fertiliser on farms has resulted in a renewed interest in methods to improve the utilisation efficiency of N sources such as fertiliser, manure and faeces/urine from grazing animals. Fertiliser is one of the largest variable costs on Irish farms accounting for over €400 million in 2009. Improving N efficiency reduces farm input costs and N losses to the environment. The main N losses with negative impacts on the environment are nitrate (NO_3) leaching to surface and groundwater and gaseous losses of ammonia (NH_3) and nitrous oxide ($N2_O$).

USING NITRIFICATION INHIBITORS TO IMPROVE FERTILIZER EFFICIENCY

Losses of N through NO_3 leaching and denitrification occur when NO_3 is present in the soil. Nitrate is produced in the soil through nitrification, which is the enzymatic conversion of ammonium (NH_4) to NO_3 by soil microorganisms. The rate of NO_3 formation in soil can be reduced by using a nitrification inhibitor to reduce the activity of specific soil microorganisms. There are a number of commercial sources of nitrification inhibitors, with dicyandiamide (DCD) being commonly used on grassland in New Zealand. Nitrification inhibitors are effective when applied directly to the soil or in combination with organic or ammoniacal N sources (i.e. non nitrate fertilisers).

EFFICACY OF INHIBITORS IN IRISH FARMING

Experiments examining the use of DCD with urine, fertiliser and manure N sources have been conducted at Johnstown Castle in collaboration with Lincoln University New Zealand, AFBI Northern Ireland and Teagasc Moorepark over the past five years. This research has shown that DCD significantly reduces NO_3 leaching from urine patches by approximately 40 per cent (Figure 1). Current legislation for acceptable NO_3 levels in water is based on concentrations. Thus, the finding that DCD significantly reduces peak NO_3 concentrations is important. Our research has shown that the use of the nitrification inhibitor DCD can reduce environmental emissions of NO_3 and N_2O. These N savings would be expected to result in increased herbage DM production, due to the higher N availability in the DCD treatments. Here our results have been conflicting. Although DCD consistently increased herbage N content, there was no consistent effect on herbage DM production.

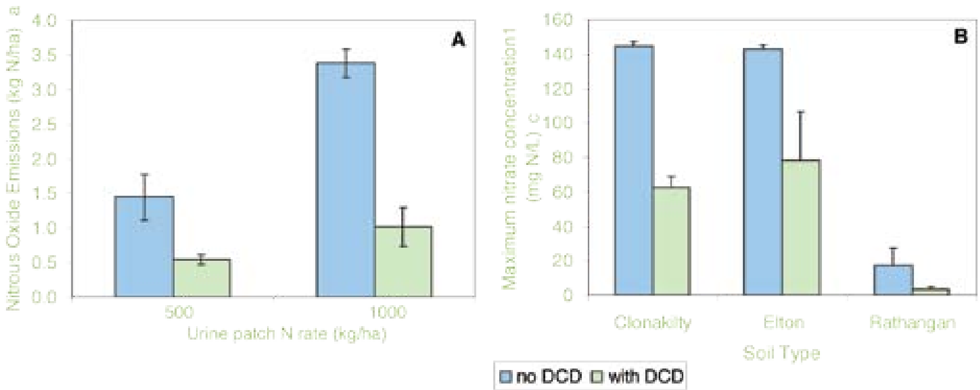

Figure 1. Effect of DCD on decreasing A. Nitrous oxide (N_2O) emissions from urine with varying N concentration and B. Maximum nitrate concentration (NO_3-N) from lysimeters of 3 different soils, receiving cow urine patches at a rate of 1000 kg N/ha

Lysimeter studies have shown that DCD increased herbage DM production by up to 35 per cent on a free draining soil under low fertiliser N inputs, but there was little response at high fertiliser N rates. Incorporation of DCD with band spread slurry significantly increased herbage DM production by 5.5 per cent in one of the two year studies. At Moorepark, low herbage DM production response to DCD has been reported. Variable responses to DCD on herbage DM production have been reported in New Zealand, with increases ranging from 1 to 21 per cent. Lower responses could be related to breakdown or leaching of DCD from the soil under high rainfall conditions. The effect of DCD on herbage production appears to be more pronounced at low N fertiliser inputs, due to lower soil N availability and thus a greater impact of N saved from loss. Nevertheless, it is under high N input situations that DCD can reduce the environmental impact of Irish agriculture.

CONCLUSIONS

Inhibitors are a useful technology to reduce environmental N losses occurring within Irish agricultural systems. Reductions of NO_3 leaching and N_2O emissions of up to 70 per cent are sizable, but currently in Ireland there is no financial benefit associated with the reduction in environmental emissions. The agronomic benefits are less clear, but there appears to be increased agronomic responses at low N fertiliser rates. Reducing fertiliser inputs to account for N saved when using DCD could offset some of the costs of DCD. Economic evaluation of the use of inhibitors in Irish agricultural systems should not be based solely on herbage DM production but should also include potential financial benefits that result from the environmental benefits. These include such as reductions in greenhouse gas emissions, and increased milk production per land area at higher animal stocking rates.

ACKNOWLEDGEMENTS

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ADDING VALUE TO MILK

Probiotic dairy products - from myth to reality

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SUMMARY

- The market potential for probiotic bacteria is expanding as the scientific evidence accumulates to support their heath-related benefits.
- *Lactobacillus paracasei* 338 is a probiotic strain which has been successfully used in the manufacture of probiotic cheese.
- As well as improving the health profile of cheese, the strain also improves cheese flavour.
- The strain has been successfully used in the development of spray-dried probiotic yoghurt. With multiple applications this ingredient is ideal for the Irish export market, especially considering the stable nature of the probiotic in the powder even at non-refrigerated temperatures.

INTRODUCTION

Even though probiotic dairy foods have been available for decades, we are only beginning to comprehend the actual health promoting mechanisms of these highly beneficial foods. Probiotics are simple bacteria, but can interact with the human host in a number of complex ways. The main site for this interaction is the human intestine. Dairy foods have proven to be the ideal matrix for delivery of probiotic bacteria to their site of action. It is therefore hardly surprising that the major probiotic products are all dairy based including Yakult, Actimel and so on. As the evidence accumulates, the market potential of probiotic dairy products is set to rise; by 2015 the global market for probiotics is estimated to exceed US$28.8 billion.

HEALTH PROMOTING EFFECTS OF PROBIOTIC BACTERIA

It is becoming more apparent that different probiotic bacteria exert different beneficial health effects on the host. Some health promoting effects which have been clinically observed for particular probiotics are outlined in Table 1.

Table 1. Positive health effects of some probiotic bacteria

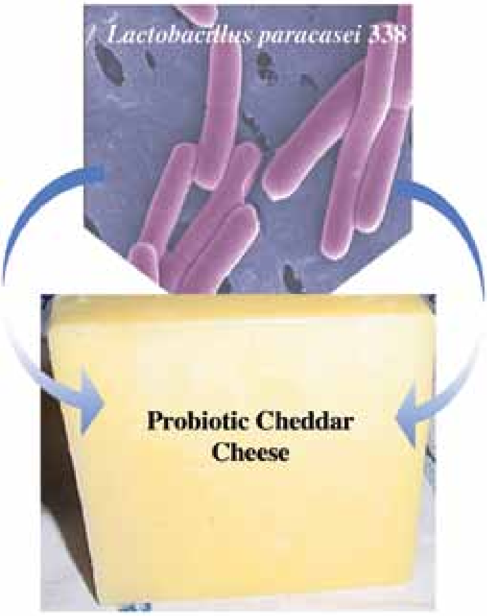
Health Effect	Probiotic Strain(s)
Alleviation of acute infectious diarrhoea in children	Lactobacillus rhamnosus GG
Prevention of antibiotic-associated diarrhoea	Bifidobacterium lactis Bb12 + Streptococcus thermophilus
Prevention of Clostridium difficile (C. dif) infection in adults	Lactobacillus casei with Lactobacillus bulgaricus + Streptococcus thermophilus
Reduction of irritable bowel syndrome symptoms	Bifidobacterium infantis 35624
Prevention of necrotizing enterocolotis	Lactobacillus acidophilus + Bifidobacterium infantis

DEVELOPMENT OF A PROBIOTIC STRAIN AT MOOREPARK AND UNIVERSITY COLLEGE CORK

The probiotic strain *Lactobacillus paracasei* 338 is of human origin and survives passage through the human gastrointestinal tract. In addition, the strain has been successfully incorporated into Cheddar cheese and has been successfully exploited in the development of spray-dried probiotic yoghurt.

CLINICAL TRIALS

The probiotic strain *Lactobacillus paracasei* 338 has been shown to increase the number of beneficial lactobacilli in the gut of healthy adults in clinical trials. In addition, the probiotic has been tested successfully in preterm babies at Cork University Maternity Hospital.



PROBIOTIC CHEDDAR CHEESE

Lactobacillus paracasei 338 grows in Cheddar cheese during manufacture and as such it is relatively inexpensive to add commercially. It can reach very high numbers in cheese of up to 0.5 billion bacteria/g.

SPRAY-DRIED PROBIOTIC YOGHURT

Yoghurt manufactured with the probiotic strain was spray-dried to develop dried probiotic yoghurt powder. The probiotic strain was stable during storage at 4°C and 15°C (for 42 days) with viable counts exceeding 10^7 cells/g, a figure which is well above the accepted limits for probiotic numbers in foods, as recommended by the World Health Organisation (WHO). The development of dried probiotic yoghurt powder offers a number of advantages over fresh product including lower water activity and thus longer shelf-life and lower transportation costs. In this sense, dried probiotic yoghurt powder offers huge potential for our export industry.

CONCLUSION

As scientific evidence accumulates, the value of probiotic dairy foods for maintaining health and well being will become more widely accepted in the public arena. Moreover, probiotic bacteria may be particularly effective for more vulnerable individuals, including those at the very early stages of life and those in the later period of life, providing unique market potential for specific population-targeted dairy products. Research in Teagasc Moorepark and UCC has demonstrated that the strain *Lactobacillus paracasei* 338 is primarily a probiotic culture, but also improves the flavour of cheese making it an ideal candidate for probiotic cheese manufacture. It's stability in spray-dried probiotic yoghurt offers a unique avenue for the export of a dairy-based probiotic ingredient and with its proven prebiotic potential, *Lactobacillus paracasei* 338 has the potential to add value to a range of dairy produce.

Cheese – A strategy for an expanded milk pool

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SUMMARY

- Cheese production offers the Irish dairy industry a value added route to market.
- Moorepark is working closely with the Irish industry to assist it in adding value to cheese and cheese products.

INTRODUCTION

Food Harvest 2020 proposes a 50 per cent increase in milk production in Ireland by 2020 based on the 2009 base line. While the capacity of Ireland to respond to this production challenge is accepted, the key to the overall success of the industry will be our capacity to process the milk into value added products that can be readily sold on global markets.

Cheese is a key product for the Irish dairy industry, with six of the major companies involved in its production. National cheese output is steadily increasing and production is now over 170,000 tonnes/annum. Cheese markets are expanding globally but in particular there will be significant opportunities in markets such as the UK, Europe and the USA. The Irish dairy industry already has an established marketing infrastructure in these countries and products from Ireland command a premium position in the eyes of consumers. For example, it is estimated that cheese consumption in Europe will increase by 300,000 tonnes per annum during the period 2010 to 2020, thus offering Ireland a unique opportunity to increase our market share in this value added market.

There has been an overdependence on Cheddar output, however, and if the industry is to maximise the return on cheese there is a need to expand the product portfolio while identifying novel approaches to adding value to Cheddar. It is well recognised that production of a diverse range of cheeses in Ireland is hampered by our seasonal milk supply. Therefore the need to support research in cheese, with particular emphasis on addressing the factors impacting on cheese quality, and diversification of the product range, has become increasingly important. The research strategy being undertaken at the Teagasc Food Research Centre, Moorepark to achieve this is based on development of scientific understanding of the impact of milk composition and quality, processing parameters, novel ingredients, starter bacteria and enzyme systems on product flavour, textural, nutritional and functional attributes and to apply such knowledge to providing solutions with commercial potential to industry.

CHEESE DIVERSIFICATION

To address the opportunities of expanding cheese markets in Europe and North America Moorepark has worked on a strategy for cheese type diversification for many years. Based on the vast experience developed, we have recently embarked on a major collaboration with the Irish industry to assist them in the development of new cheese types. Based on market intelligence, the industry identifies particular cheeses where opportunities exist. Moorepark is then provided with samples of such cheeses which are "mapped" in fine detail based on the extensive analytical capability available at the centre. This information is then used to derive manufacturing processes that are likely to lead to cheeses with the desired sensory and functional attributes. Cheeses manufactured based on these recipes are then analysed during ripening in collaboration with industry personnel and products demonstrating commercial potential move on to a scale up phase. Based on this model a continuous pipeline of cheeses are under development with new concepts added as existing ones either move on to industrial evaluation or are terminated if the information collected suggest that they will be too difficult to manufacture under Irish conditions.

ADDING VALUE TO CHEDDAR

Over 80 per cent of the cheese currently produced in Ireland falls into the Cheddar category, much of which undergoes secondary processing for ingredient applications and most finds it way to market via a "business to business" (B2B) route. Even with an expanding milk pool and a greater drive for diversification of cheese type, Cheddar will continue to be the dominant cheese produced in Ireland over the coming years. The focus of the industry in this area will be to improve manufacturing efficiency and to add value through various approaches such as enhancing flavour, nutrition or technological functionality. Moorepark is very active in this area and is working closely with industry on topics such as fat and salt reduction, accelerated ripening and enhanced flavour development, modified technological functionality and manufacturing efficiency. An industry based Cheese Forum is operated where many of these issues are addressed in collaboration with industry.

NEW APPROACHES TO CHEESE MANUFACTURE

The conventional approach to cheese manufacture is dependent on a supply of fresh milk. However, new approaches to manufacture cheese from novel dairy ingredients are being investigated at Moorepark. While still at an experimental and pilot plant level, the process is demonstrating promise and its progress is being closely followed by industry. If successful, this novel technology will provide an opportunity for the Irish industry to greatly expand its cheese range, in particular in the ingredient cheese sector and will also free this sector from the constraints currently experienced due to seasonal milk production.

CONCLUSIONS

The full benefits of expanded milk production will only be realized if the milk is manufactured into value added products. Such added value can be achieved through cheese; however, the full benefits will only be achieved from a more diverse range of cheeses that meet consumer expectations and Cheddar cheese with added functionality will have to be produced. The cheese science and technology platform at Moorepark will be an important partner with industry in achieving this strategy.

Developments in infant milk formula manufacturing

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SUMMARY

Teagasc Food Research Centre Moorepark (TFRCM) is engaged in a number of major research initiatives aimed at consolidating the manufacturing competitiveness and the unique market opportunity for innovative dairy ingredient supply to infant milk formula (IMF) manufacturers:

- Development of innovative ingredients for exploitation by dairy companies supplying to IMF manufacturers.
- Performance evaluation of novel and commercially-sourced ingredients in a simulated IMF processing platform at Moorepark.
- Development and formulation of intermediate base IMF products for supply to new market entrants.
- Spray drying characteristics of adapted formula, especially those prone to increased stickiness during drying.
- Provision of IMF operator training courses.
- Troubleshooting IMF processing problems.

INTRODUCTION

For several decades, infant milk formula manufacture in Ireland had a low key presence in the Irish dairy industry landscape – the mainly multinational-based companies having originally established manufacturing sites to source relatively small volumes of local milk and whey supplies, and apart from that the businesses operated in a virtually detached manner. Today, it is a very different story! Not alone have these companies grown considerably in manufacturing scale, but they are expanding the developmental roles of their Irish-based operations to service growing global market opportunities using locally-sourced milk and primary-processed milk-derived ingredients. The business model now taking shape is highly important – foreign direct investment engaged in not only manufacture, but in partnering with Irish milk processors for the supply of milk, added value dairy ingredients and premium selected commodity milk powders. The major benefit to Ireland and the Irish dairy farmers derives ultimately from leveraging the strength of the global brands and market reach of these highly specialised multinational nutritional companies. Other benefits include assured demand for an anticipated expansion in milk production post milk quota in 2015, a manufacturing scale capable of diverting large volumes of seasonally-produced milks from reliance on commodity dairy products, and demand for scientific and technological skills appropriate to this food sector.

QUALITY AND FOOD SAFETY ASPECTS

While this is an excellent market opportunity for the Irish dairy farmer, it also has its challenges. The image of quality Irish milk produced on lush green pastures comes at a cost of having to endure large fluctuations in milk constituents, not just in the familiar fat, protein and lactose components, but also in minerals and vitamins. Infant formula is manufactured to exacting compositional standards, as is evident when one reads the declaration on the side of a retail pack. Consequently, infant milk formulators have to wrestle with this variability and readjust their recipes when combining various dairy ingredients (skim milk powder, whey proteins etc.). Quality along with food safety, of course, pervades the whole chain from farm to fork and spans microbiological as well as chemical residues and contaminants. This is understandable so when one considers the vulnerability of the target consumer – newly-born infants. Constant vigilance is, therefore, required when considering the threat posed by emerging pathogens at all stages from farm to 'nursing bottle' such as listeria, particular strains of *E. coli* and *Chronobacter sakazaki*, in particular. Current research at TFRC and elsewhere is providing insights into the growth characteristics, use of rapid assays, and natural antimicrobial agents that may offer potential for their control.

DIFFERENCES BETWEEN COWS AND HUMAN MILK

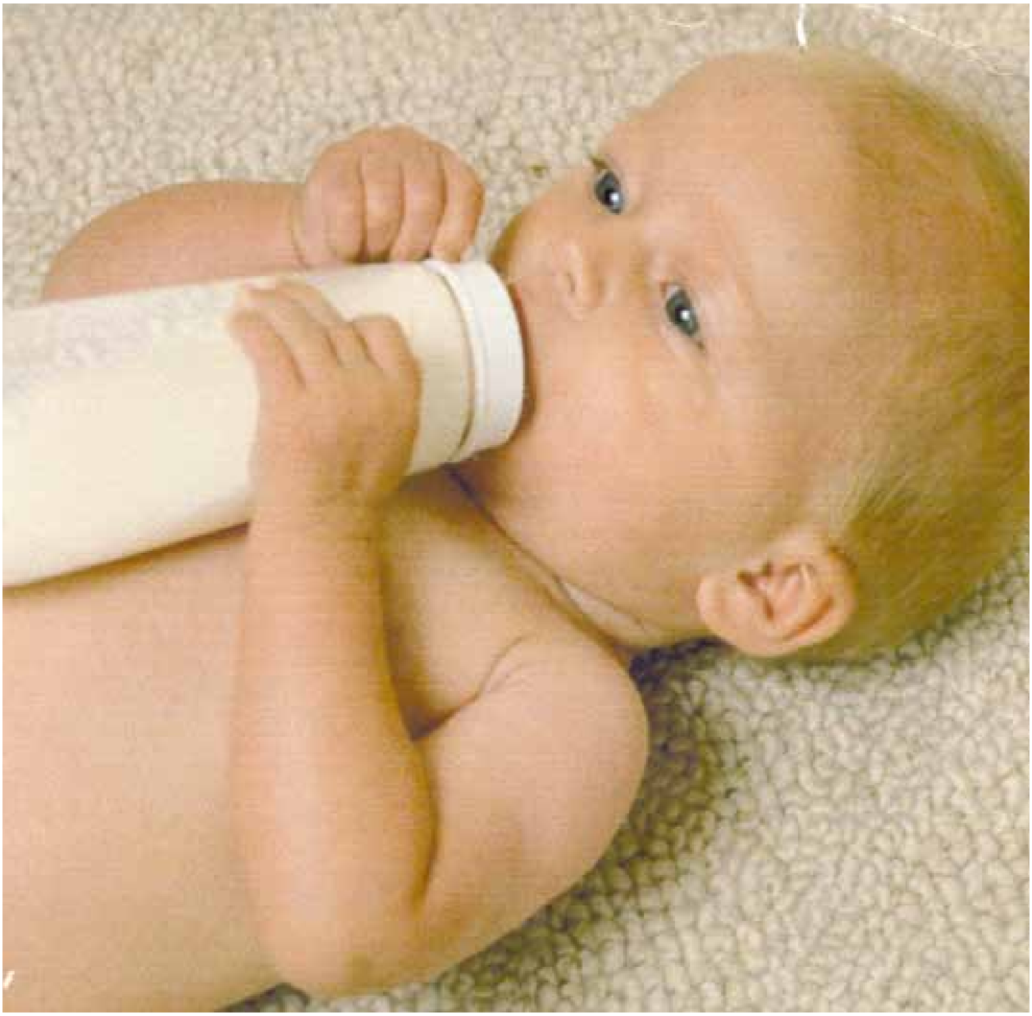
Cows milk is not all suited to the nutritional and physiological requirements of the new born baby. Firstly, there is too much overall protein in cows milk as well as protein fractions not being in the correct concentrations. Mineral concentrations are too high and potentially damaging to the kidneys of the new born due to renal overload. However, as the infant matures, its increasing appetite may be addressed with a milk composition that more closely resembles cows milk. Hence, the mismatch between bovine and human milk has underpinned the need to 'humanise' i.e. adapt the composition of cow's milk to that of human milk over the years. Considerable strides have been made in compositional adaptation of so-called 'First-age' formula, principally in relation to protein content, reversal of whey/casein ratios, elevation of lactose content and reduction of mineral content. Moorepark's innovative technology for the enrichment of the α-lactalbumin fraction of whey protein was commercialised as a means of bringing IMF 'humanisation' a step closer to human milk where scarcely any of the β-lactoglobulin fraction exists. Other steps are also being investigated to reduce the incidence of allergy to cow's milk e.g. hypoallergenic milk protein hydrolysates help fight competition from non-dairy sources.

Novel shockwave heating/mixing technologies have been developed with a view to re-engineering existing infant formula manufacturing processes in order to make them less energy-intensive and more competitive. In the past, the chain of events in the IMF manufacturing cycle utilised multiple energy demanding dehydrating steps. Other candidate milk components currently of potential interest to IMF include milk fat globule membrane (MFGM) and milk oligosaccharides. A more sustainable IMF manufacturing industry in the future will be based on a shorter processing chain between milk source and consumer. Customised IMF base products to which other ingredients are dry-blended will also suit export market localisation.

CONCLUSIONS

The unique capabilities established at Moorepark are now firmly established and playing a pivotal role in the national infrastructure that is supporting IMF growth and development. Industry integration is founded on the availability of a sustainable high quality milk supply that can be processed into functional dairy ingredients that enable IMF manufacturers to achieve final product specifications.

The knowledge that drives this research and delivery to industry relies extensively on the Centre's scientific and technological expertise and dedicated facilities which have been built up over time and are now supporting all stakeholders to gain strategic market advantage on behalf of Irish milk producers.



IRISH RECOMMENDED LIST OF GRASS VARIETIES 2011

DEPARTMENT OF AGRICULTURE FISHERIES AND FOOD
IRISH RECOMMENDED LIST OF GRASS VARIETIES 2011

Variety	Group	Heading Date	Ploidy	Total Yield t DM/h	Spring Growth t DM/ha	Autumn Growth t DM/ha	Ground Cover (Scale 1-9)	DMD %	WSC %
Early PRG Control Mean				**15.6**	**1.5**	**3.2**		**80.4**	**18.4**
Donard	Early	14 May	D	101	100	104	6.3	100.0	97
January	Early	16 May	D	100	114	99	6	99.0	100
Intermediate PRG Control Mean				**15.3**	**1.3**	**3.0**		**81.1**	**18.3**
Shandon	Inter	23 May	D	97	98	95	6.9	98.6	96
Solomon	Inter	25 May	D	101	122	103	7.0	(99.6)	(96)
Premium	Inter	29 May	D	98	92	99	7.2	99.5	97
AberStar	Inter	1June	D	99	91	107	7.0	(101.0)	(105)
AberMagic	Inter	n/a*	D	101	92	115	7.3	101.8	125
Malone	Inter	22 May	T	104	109	105	6.0	100.8	109
Giant	Inter	22 May	T	102	114	103	7.1	(100.1)	(106)
Magician	Inter	23 May	T	102	113	101	6.5	100.6	101
Lismore	Inter	27 May	T	99	90	97	6.4	100.4	100
Trend	Inter	27 May	T	104	100	102	6.3	(100.7)	(102)
Edda	Inter	28 May	T	101	98	101	6.2	101.1	105
Dunluce	Inter	1 June	T	102	97	108	6.3	102.7	120
Late PRG Control Mean				**14.8**	**1.1**	**3.1**		**82.2**	**18.3**
Denver	Late	5 June	D	98	97	97	7.3	99.4	91
Soriento	Late	5 June	D	98	92	96	7.4	99.5	95
Tyrella	Late	5 June	D	98	130	99	6.8	100.2	107
Tyrone	Late	5 June	D	96	84	102	6.9	99.5	103
Portstewart	Late	7 June	D	98	92	101	6.9	100.1	102
Mezquita	Late	7 June	D	98	105	8	7.7	(99.2)	(94)
Drumbo	Late	9 June	D	99	105	104	7.0	100.8	114
Malambo	Late	11 June	D	99	96	104	7.0	98.3	93
Twystar	Late	11 June	D	97	98	101	7.2	99	99
Cancan	Late	12 June	D	97	83	105	7.3	99.7	108
Orion	Late	2 June	T	100	95	98	6.6	101.3	112
Delphin	Late	2 June	T	104	107	103	6.4	100.8	104
Glencar	Late	3 June	T	102	105	100	6.4	99.7	98
AberCraigs	Late	5 June	T	101	101	101	6.4	100.8	109
Navan	Late	7 June	T	102	89	111	6.6	101.0	112
Twymax	Late	8 June	T	101	87	101	6.7	(102.2)	(115)

Values presented for yield, DMD and WSC of individual varieties is relative to the control mean
n/a insufficient data, considered latest in group; () indicates provisional data. See www.agriculture.gov.ie/publications/2011/ for more information*

NOTES